Electrical News
Generation Transmission and Application of Electricity

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Auxiliary Plants

The present-day tendency in the larger hydro-electric generating plants in Canada is decidedly in favor of some form of auxiliary equipment. The present issue of the Electrical News contains a detailed description of the new steam turbine generating station just completed by the Winnipeg Electric Railway Company. Recent issues have described similar stations in Vancouver and Victoria erected by the B. C. E. R. Co. At the present time the Toronto Railway Company and the Toronto Electric Light Company are installing auxiliaries in the form of both steam turbo-generators and very large storage batteries. The Electric Power Company is just completing the installation of a Diesel oil stand-by in Oshawa, in addition to several steam plants already available at different points along their distributing system. The Ottawa Light, Heat & Power Company and the Ottawa Street Railway Company are also at present increasing their auxiliary equipment, and many other companies are following the same policy in a somewhat smaller way. It is noticeable, too, that these companies are all, or nearly all, possessed of what may almost be considered as unlimited water powers operating under very favorable conditions as to development and transmission.

The last few years have shown large improvements in the efficiency of prime movers in general and this is probably most marked in respect to the steam turbine, which is taking the place, to a considerable extent, of the reciprocating steam engine. Improvements in steam auxiliary equipment such as the automatic methods of handling coal and ashes have also added much to the over-all efficiency of these plants. As a consequence, the modern steam plant is capable of showing often as good results as the hydro-electric plant and this, coupled with the well-recognized advantages of having a second source of power in case of emergency, or to carry the peak load, has finally decided the larger companies in favor of such installations. No doubt with further improvements the practice will become more general and the day is apparently not far distant when the lack of near-by water falls will not be considered an insuperable obstacle in the way of cheap rates.

And with this improved steam equipment another phase of the power supply question is brought prominently to the front. At many points in Canada there are vast deposits of a fair quality of coal which, however, in the past, has been considered of too low a percentage in carbon content to justify, under the existing freight rate, its transportation over any considerable distance. Conditions even now point to a solution of the power supply to many cities, in our prairie provinces especially, in the installation of steam generating equipment at the source of supply, which, supplemented by high tension transmission lines, may easily become as efficient and as dependable and almost as inexhaustible a source of energy supply as our present hydro-electric systems.

Care of Storage Batteries

The winter care of storage batteries is the subject of a timely and helpful article by Mr. A. E. Wilkes in our present issue. It is not possible to calculate to what extent the more general use of storage batteries has been retarded by a lack of knowledge as to their proper care, far more than any other piece of electrical apparatus, possibly, the storage battery is susceptible to ill-treatment. On the other hand, careful and intelligent attention to a storage battery's needs will result in greatly increased efficiency and a much longer life, and incidentally will assist in readjusting the public's somewhat unfavorable opinion of storage batteries in general. The storage battery in its present state of development is a very useful equipment and is surrounded by great possibilities. With the gradual improvements that are pretty sure to develop, and with a little more technical knowledge on the part of the operator which will result in a more sympathetic attention to the needs of his batteries, the storage cell may be expected to meet with a much wider and more general application in the near future. The action of two Toronto companies in installing large storage battery plants for stand-by purposes indicates the trend of expert opinion regarding this type of equipment.

Toronto is Business-Like

Toronto, during the month of December has opened for service some two miles of municipal electric railway line. It would probably not be claimed by anyone that this street railway work was, in the earlier stages, carried forward with any marked enthusiasm, but it must have been a pleasure to every citizen of Toronto to watch the business-like progress of the last few weeks, during which time the service wires have been laid, the motor generators installed, the cars purchased and delivered, not forgetting the snow-sweeper, and everything has been set running smoothly. It does not matter greatly that this line will not, temporarily, pay expenses, though, if the same "free hand" is given to the same man who has already done such effective work, it is quite likely the deficit will not be long-lived. This example plainly points a good course for any municipality to follow,—employ men with good business instincts, pay them whatever is necessary to keep them, give them all the authority necessary to get results and keep the council occupied, for the time being, with something else.

New Hydro Rates

Further reductions, based on actual consumption, have been made in the price to be charged the different municipalities under their contract with the Hydro-electric Power Commission of Ontario. The following table gives the present and the new rate which, with the exception of some half dozen cases, represent a substantial reduction from the rates published in our November issue, and which at that time were based on estimates which have since been more than fulfilled:

	Present Rates	New Rates
Baden	$37.00	$37.00
Beachville	33.89	31.00
Berlin	25.00	22.50
Brampton	29.00	25.00
Dundas	17.33	16.00
Galt	25.00	22.00
Guelph	25.00	22.00
Hamilton	17.90	16.00
Hespeler	26.00	23.00
Ingersoll	28.00	25.50
London	28.00	24.00
Mimico	30.74	30.00
Mitchell	38.00	37.00
New Hamburg	32.00	32.00
Norwich	30.00	32.00
Port Credit	36.79	31.00
Preston	25.00	21.50
Seaforth	41.00	40.00
St. Marys	38.00	29.50
Stratford	32.00	30.00
St. Thomas	32.00	29.00
Tillsonburg	32.00	32.00
Toronto	18.10	15.00
Waterdown	37.50	26.00
Waterloo	26.00	23.50
Weston	30.00	30.00
Woodstock	26.00	23.00

An Act Respecting Radio-telegraphy

As the result, in part, no doubt, of the very large number of amateur and semi-commercial wireless telegraph outfits that are being installed now-a-days, and which interfere more or less with the legitimate business of the Dominion or of the government, an Act to regulate these has been introduced in the House of Commons by Mr. Hazen By this Act no person shall establish any radio-telegraph (this term including any wireless system of conveying electric signals or messages including radio-telephones)station or install or work any radio-telegraph apparatus in any place in Canada or on board any ship registered in Canada except under and in accordance with a license granted by the Minister.

The Act further states that after July 1, 1913, no passenger steamer, whether registered in Canada or not, carrying fifty or more persons, including passengers and crew, shall leave or attempt to leave any Canadian ports unless such steamer is equipped with an efficient radio-telegraph apparatus in good working order capable of transmitting and receiving messages over a distance of at least 100 miles by night or day, and in charge of a person fully qualified to take charge of and operate such apparatus.

Inland Revenues Report

The report of the Inland Revenues Department for the year ending March 31, 1912, with reference to weights and measures, gas and electricity, is just to hand. The report shows that the total expenditure in connection with electric light inspection for the year, amounted to $35,005.20, as against a revenue of $66,561.20. The number of electric meters presented for verification during the year, totals 93,295. It is interesting to note that of this number 35,494 registered correct, 38,526 a little fast, 19,084 a little slow, both of these latter, however, falling within the error tolerated by law. The total number of rejected meters, therefore, only amounted to 178, as compared with 93,117 verified.

The number of electric light companies and corporations registered under the Electric Light Inspection Act during the year ending March 31, 1912, totals 426, and the number of 16 carbon candle power equivalents supplied amounts to 4,315,807. To this total amount the larger cities contribute approximately as follows:—Montreal, 625,000; Toronto, 520,000; Vancouver, 400,000; Winnipeg, 280,000; Ottawa, 250,000; Quebec, 140,000; Hamilton, 137,000; Victoria, 110,000; Halifax, 65,000; Calgary, 60,000; London, 55,000; St. John, 50,000.

Under the heading of Electrical Energy Generated for Export and for Consumption in Canada, nine companies are now included, four of which appear for the first time. These are the Electric Distributing Company, of Windsor, Ont.; The Sherbrooke Railway and Power Company; The B. C. E. R. Company, and the Western Canada Power Company. Of these the first two have not yet begun to export, but have been granted a license to do so. The other two have been exporting for a part of the year only. The accompanying table gives the exact figures under this latter head:

Statement showing total amount of Electrical Energy expressed in Kilowatt Hours and Horse Power Years, Generated for Export and for Consumption in Canada, by the Hydro-Electric Companies during the Fiscal year ended March 31, 1912.

Name of Contractor.	Place of Business.	Units Generated for Export.		Units Generated for Consumption in Canada.		Total Output of Generating Station or other Sources.	
		Kilowatt Hours.	H. P. Years.	Kilowatt Hours.	H. P. Years.	Kilowatt Hours.	H. P. Years.
Ontario & Minnesota Power Co	Fort Frances, Ont.	18,920,173	2,895.22	1,407,804	215.42	20,327,977	3,110.64
Canadian Niagara Power Co.	Niagara Falls, Ont.	295,125,050	45,160.95	11,903,550	1,821.52	307,028,600	46,982.47
Electrical Development Co	" " "	8,274,600	1,266.25	135,473,774	20,730.62	143,748,374	21,996.87
Ontario Power Co.	" " "	213,658,241	32,694.65	199,658,759	30,552.47	413,317,000	63,247.12
†Electric Distributing Co.	Windsor, Ont.	....	....	....	....	....	....
*Sherbrooke Ry. & Power Co	Sherbrooke, Que.	....	....	....	....	....	....
Maine & New Brunswick Electric Power Co.	Aroostook Falls, N.B.	2,002,557	306.44	55,649	8.51	2,058,206	314.95
British Columbia Electric Ry. Co.	Vancouver, B.C.	⊙64,820	⊙9.92	80,152,596	12,265.20	80,217,416	12,275.12
‡Western Canada Power Co.	" "	30,960	4.74	1,154,547	176.67	1,185,507	181.41
	Totals.	536,076,401	82,338.17	429,806,679	65,770.41	967,883,080	148,108.58

† No plant installed yet, though export license was issued in June, 1911.
* License issued in December, 1911, but nothing was exported during the above fiscal year.
⊙ For last four months only of fiscal year, as export did not start till December, 1911.
‡ For last three months only of fiscal year, as export did not start till January, 1912.

Trent River, Dam No. 5

The Electric Power Company are pushing actively the work of construction at Dam No. 5 on the Trent River, below Frankford, with the intention of completing the installation before the winter sets in. There have been serious difficulties to contend with owing to the exceptionally high water during the summer, but the work has now reached a stage at which the construction can be carried along without fear of further delay. The installation of the equipment is at present under way. The electrical equipment consists of four 812½ kw., 7000 volt, 3-phase, 60 cycle, vertical-shaft generators, operating at 112½ r.p.m.; one 75 kw., 225 r.p.m., vertical-shaft compound wound, d.c. generator, direct connected to vertical turbine with ball thrust bearing for carrying the total weight; and one 75 kw. motor generator set. The generators and exciters were manufactured by the General Electric Company of Sweden, and supplied by Messrs. Kilmer, Pullen & Burnham, Limited, Toronto. The switchboard is being built by the Monarch Electric Company, who also supply the necessary cables and connections. The hydraulic equipment is supplied by the Canadian Boving Company, Toronto, and consists of four vertical double-runner turbines, 1500 B.h.p., 112½ r.p.m. This plant is a duplicate of that already in operation at Dam No. 2. It is expected that water will be turned into the new installation before Christmas.

Renfrew Operating

The Corporation of Renfrew have recently put their new hydro-electric plant into operation and the tests made have demonstrated the fact that the design and lay-out of the whole equipment are strictly up to the best standards. The buildings are tastefully designed and the hydraulic lay-out guarantees operation under the most difficult conditions. The electrical equipment consists of two 250 kilowatt, 400 r.p.m., 2300 volt, 2-phase, 60 cycle, a.c. generators, one unit being direct connected at one end to a water wheel and at the other end to a Bellis & Morcom high speed engine. The second unit is driven by a water wheel alone and this machine is equipped with direct connected exciter.

The hydraulic apparatus was supplied and installed by the S. Morgan Smith Company, of York, Pa., and the generators and exciters by Messrs. Kilmer, Pullen & Burnham, Toronto, sole dealers for the General Electric Company of Sweden. The switchboard was supplied and installed by the Canadian Westinghouse Company. Mr. J. B. McRae, of Ottawa, acted as consulting engineer on the undertaking, and Mr. J. R. Stewart, town engineer of Renfrew, supervised the work of construction for the corporation.

Hamilton is Prosperous

The Commissioner of Industries of Hamilton, Mr. H. M. Marsh, has prepared a very interesting report on the industrial development of that city during 1912 and the outlook for 1913. The report states that on every hand there are indications of great prosperity and that the development and expansion during 1912 has been so far in advance of all previous years that it may be called phenomenal. The report goes on to show the number of industries secured by Hamilton during the past year. These have been attracted largely by the electrical facilities of that place, Hamilton now being served both by the Hydro-electric Power Commission of Ontario and by the Dominion Power and Transmission Co. The power requirements of the city under their agreement with the Commission have increased so rapidly that the rate is even smaller than was anticipated and there are indications of further reductions.

Activity in the Maritime Provinces

The Nova Scotia Knitting Co., Eureka, N.S., are installing an electric lighting system in their mills and in addition will light the town of Eureka.

The electors of Dalhousie, N.B., have voted thirty thousand dollars for the installation of an electric light plant. Willis Chipman, C.E., of Toronto, has been engaged by the town to prepare plans and specifications.

The Eastern Hat & Cap Co. of Truro, N.S., are installing an electric light and power system in their new factory at Truro. The system will be 220 volt, direct current, the lighting being done with 55 volt tungsten lamps placed four in series.

The town council of Trenton, N.S., recently decided to illuminate the streets of that town and have entered into a contract with the Pictou County Electric Co. for the installation of one hundred sixty-watt series tungsten lamps. This town is having quite a boom at present on account of the Eastern Car Co. erecting their street car building plant there.

The Canadian Car & Foundry Co., Amherst, are making extensive additions to their car building plant. These additions will require some five hundred horse power in motors. The current to operate same will be purchased from the Canada Electric Co. The Canadian Car & Foundry Co. are also installing motor drives in the new addition to their malleable iron works.

G. R. Marshall, of Stemacke, N.S., has recently installed a lighting system in that town. The generator, a 50 kw., 3 phase, 2200 volt belted unit, is operated in his steam mill. In addition to lighting the town of Stemacke, Mr. Marshall has also bought out the Shubenacadie Electric Co. and is now operating the latter from Stemacke over a four mile single phase transmission line.

The Maritime Motor Car Co. of St. Johns, N.B., are erecting a plant at Cold Brook, N.B., for the manufacture of high grade automobiles. The buildings, two in number, each 250 ft. x 100 ft., will be equipped with electrically driven machinery. For the present current will be purchased from the St. John Ry. Co. The lighting of buildings will be done by flame arc lamps and 55 volt tungstens. The company plan on installing their own power plant at a later date.

The Acadia Sugar Refinery Co. whose plant at Woodside, Dartmouth, was destroyed by fire, are now rebuilding on a very extensive scale. This plant will be operated throughout with individual electric drive. The specifications for power plant are not out yet. James Buchanen of Liverpool, England, are the consulting engineers. An addition is being made to the boiler plant and a smoke stack 260 ft. high is being erected. This stack has a diameter of 21 ft. at the base and when completed will be one of the largest in Canada.

The Nova Scotia Carriage and Motor Car Co. have about completed a four storey brick factory at Amherst, N.S. The main building is 300 ft. x 100 ft. and will be used for the manufacture of motor cars and carriages on an extensive scale. The office and power house are situated in separate buildings. The factory will be operated throughout with 3 phase, 60 cycle, 220 v. motors ranging in size from one to twenty horse power. The power house equipment consists of one [illegible] phase, 60 cycle, 220 volt, 187 kv.a. 167 r.p.m. C. G. E. generator direct connected to a Robb Corliss engine. The building will be wired in conduit, the lighting being done with 55 volt tungsten lamps.

The Makers of Electrical Canada—15

R. F. HAYWARD—HYDRO-ELECTRIC ENGINEER

The subject of our sketch this month, Mr. R. F. Hayward, general manager of the Western Canada Power Company, Limited, Vancouver, B.C., was born at Harrow, England, in the year 1865, and received his early education at Harrow School, afterwards attending classes at the University College, Engineering School, London. In 1885 he became a pupil of Crompton & Company, Chelmsford, Eng., and went through the mechanical shops of the firm as an apprentice. Later, in 1889, Mr. Hayward became works manager for the company, and held this position until 1894, when he joined the Salt Lake and Ogden Gas & Electric Light Company at Salt Lake City, Utah, acting as general manager for this concern until 1897. In that year he was appointed chief engineer of the Utah Light & Railway Company.

During his stay in Utah, Mr. Hayward was engaged in the development of long distance transmission of power in that state, including the construction and operation of several hydro-electric plants and about 200 miles of transmission line. Leaving the last named company in 1905, he sought a new field of activity in Mexico, and was general manager of the Mexican Light & Power Company in Mexico City from 1905 till 1909. During this period he superintended the construction and operation of a 40,000 h.p. hydro-electric power plant, including 170 miles of high tension transmission line for the same company. When the Mexican Light & Power Co. was taken over during 1909 by the Mexico Tramways Co., Mr. Hayward resigned his connection with the former company and returned to Canada to associate himself with the directorate of the Western Canada Power Company. He later went to British Columbia as general manager of this company, towards the end of 1909, since which date he has designed and constructed the Stave River Falls plant near Ruskin, B.C., some thirty-five miles east of Vancouver. This plant is regarded as one of the finest examples of efficient engineering practice on the continent to-day. It has a present capacity of 25,000 h.p. in two units, but plans are already under way for further additions. The total final development at this point will be approximately 100,000 h.p.

Mr. R. F. Hayward

Mr. Hayward is also intimately associated with the construction plans and management of the Prince Rupert Hydro-electric Power Company, who control water powers in the vicinity of Prince Rupert, B.C., aggregating some 30,000 h.p.

Mr. Hayward is a member of the American Society of Civil Engineers and of the American Institute of Electrical Engineers.

The Cost of Service

Some interesting information was recently brought forward by the New York Edison Co., who appeared before the Public Service Commission for the First New York District as the result of a petition that had been filed to the effect that the rates of the New York Edison Co. discriminated unduly in favor of large users of energy and that the rates charged to smeller users were excessive and out of proportion to the cost of production. In the course of an examination of Mr. Geo. W. Lieb, Jr., 3rd vice-president of the company, it was stated that the average 10-c. or retail customer, the customer who never uses an excess of 250 kw. hours monthly and who, as a class represents nearly 80 per cent. of all the commercial customers on the company's books, is actually being served below the average cost for rendering this particular service and therefore at a direct loss to the company.

This company had placed certain new reduced rates in effect on July 1st, 1911, as a result of which there was a total decrease in revenue from all sources in the twelve months ended July 31, 1912, of approximately $1,250,000, of which $850,000 or approximately 70 per cent. was attributable to the small lighting customer. Mr. Lieb stated that the company's experience showed that there was no appreciable addition in new business as a result of the new rates which confirmed his past experience as to the futility of relying upon any considerable increase in new business and revenue, over the usual natural growth, as an offset to the direct loss of revenue attendant upon the introduction of lower rates. Under the new schedule of rates the average return is 6.87c. per kw. h., while the average cost of serving all the customers of the company is given as 3.68c, per kw. h. exclusive of fixed charges, dividends, etc.

In justification of the general policy of giving a lower rate to the larger customers the witness stated that in his company the service connection for the small consumer represents an investment of over $65 per customer or more than $542 per kw.h., which decreased in proportion as the size of the installation increased.

The Vibrating Rectifier

A new device has recently been brought out for mechanically changing alternating current of standard voltage to low voltage direct current. The photograph and diagram shown herewith will represent the principle on which the rectifier works. It is essentially an electrically operated vibrating switch which reverses the connection of the alternating current line to the battery in synchronism with the alternations of the current, this reversing action being accomplished at the moment when the current flow is zero. The result is the delivery to the battery of an intermittent pulsating current always in the same direction which charges the battery in the same way as would a constant voltage direct current.

The movement of the vibrating switch is controlled by two alternating current magnets, M M Fig. 1. A small two-winding transformer reduces the a.c. line voltage to the proper value for charging the battery. In this figure A B represents the primary and C D E the secondary side of the transformer. Across one half of the low voltage winding the two a.c. magnets are connected as shown in Fig. 1 between C and D. These magnets are so wound that the lower ends have always the same polarity, that is, during one half wave of the alternating current the lower ends of each of the magnets M M will be a north pole and during the other half of the wave each of the lower ends will be a south pole. A permanent oscillating magnet F H hinged at G is placed relatively to the a.c. magnets as shown. Platinum contact points close the circuit alternately at F and H as the magnet oscillates. In practice F H is magnetized directly from the battery which thus maintains the poles permanently the same.

The operation of the rectifier is briefly as follows: If E is positive to D the current flows from E to D to P to N to G to H to E, the winding of M being such as to draw the point F away from its platinum contact and depress the end H thus closing the circuit at H. When C becomes positive to D the current flows from C to D to P to N to G to F to C, the change in current direction in

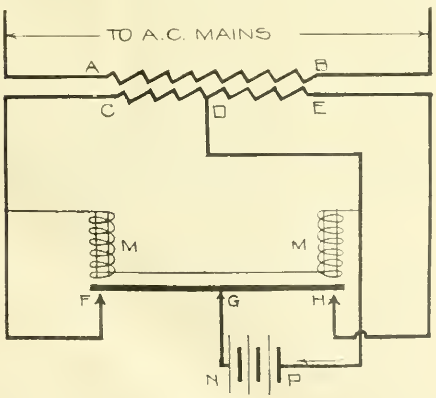

Fig. 1

the magnets M M having reversed their poles so that H is now drawn up, and F is depressed making contact at that point.

In actual practice, regulating resistances are installed between E and H, C and F, M and M, and condensers properly placed absorb any induction effects which follow the breaking of the current at F and H.

The rectifier as yet, has not been developed for universal use and operates best on 60 cycle current at anywhere from 100 to 120 volts. Under these conditions it gives a sufficient voltage to charge three cells at a rate of from six to eight amperes. It will thus be seen that the device is particularly valuable in charging small batteries and it is specially designed for the use of automobile owners who use a small battery for lighting or ignition purposes. The vibrater occupies very little space and can be hung on the wall or carried around in the tool box of an automobile. It costs only about 1c per hour to operate on the basis of 10c per kw h. for power. Another useful factor in the consideration of this rectifier is that it makes no difference, in practice, how the battery is connected up, inasmuch as the direct current magnet being energized from

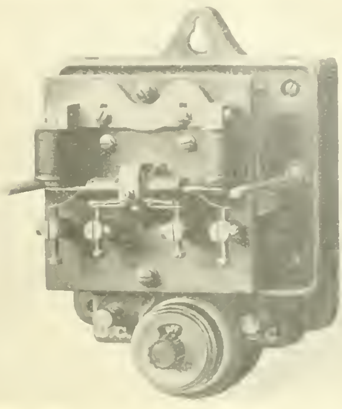

Fig. 2

the batteries, will change its polarity to suit the changed conditions. Fig. 2 is a photograph of the vibrater with cover removed. The function of the different parts can be traced by comparison with the line sketch above.

Winter Care of Storage Batteries

By Mr. A. E. Wilkes

The use of storage batteries in connection with gas engines is becoming so common for ignition as well as lighting and power that information in regard to their proper treatment should be of interest to a very large percentage of gas engine users.

At this season of the year, the question which naturally arises is as to how they are affected by cold; what special precautions should be taken; or, when only used in the summer, how are they to be taken out of commission.

With proper precautions there need be no fear of a storage battery freezing and causing breakage, even at very low temperature. Electrolyte of a specific gravity of 1.210 freezes or congeals at about 25 degrees below zero. This strength of electrolyte is used in most stationary batteries. Portable cells, whether of the ignition or vehicle type use much stronger electrolyte, and freeze at still lower temperatures. Further, where electrolyte freezes it does not freeze solid but forms a slushy mass, which is not likely to cause breakage.

Where water is simply poured into the cells without any mixing, it is apt to collect largely on top of the electrolyte, so this water will naturally freeze solid, and may cause breakage if the temperature drops below the freezing

point. In order to avoid so-called stratification, water should preferably be added to the cells when they are just beginning to gas on charge, and the charge continued until the cells have gassed freely for an hour or so. The gassing will then thoroughly mix the electrolyte and water and eliminate all danger of freezing. If the plant is out of commission, or it is not practicable to charge during the addition of water, the electrolyte and water should be thoroughly stirred, using some kind of non-metallic paddle or stick. As it is quite difficult to mix electrolyte and water in this manner, a great deal of stirring is required, and an upward motion should be given to the paddle in order to lift up the strong electrolyte and mix it with the water. Where practicable it is decidedly preferable to charge the battery during the addition of water rather than to depend upon mechanical stirring.

As will be seen, any danger from breakage due to cold can be quite easily eliminated, but there is another effect of cold upon storage batteries which is not so easily handled, viz., the reduction in the available capacity. This reduction is not permanent, as the capacity is restored without any injury to the plates when the temperature is brought back to normal, but especially in the case of lighting plants, greater capacity is often needed in winter than in summer, and unless plenty of capacity has been provided, this matter may sometimes prove serious.

The first remedy which suggests itself is heating, and this will, of course, take care of the trouble and is the best solution where the conditions are such that heating is practicable. There are, however, many cases, especially small isolated plants, where it would be difficult as well as expensive to provide heating. Fortunately most of these plants are installed with sufficient capacity to carry the load for several days or a week, and in such cases all that is necessary is to charge more frequently in order to avoid reaching the discharge limits. In cases where there is only sufficient capacity for one day at normal temperatures, it will be necessary either to provide heating or increase the capacity. In small plants it will generally be found more economical to increase the capacity of the storage battery, as the cost of this will not be great as compared with the expense and trouble of heating and the extra capacity means longer life for the plant.

The reduction in capacity from low temperatures varies somewhat with the type of battery and the discharge rate, but in the types of service we are considering it may be figured at approximately one-half per cent. per degree Fahrenheit below normal. On this basis for example, at a temperature of thirty degrees Fahrenheit, the reduction would be some twenty per cent., or the available capacity would be reduced about one-fifth.

Cold increases the charging voltage of a storage battery, so that where cells are charged, through fixed resistances, the charging rate may be reduced, and thus a longer charging time be required in order to restore the capacity to the cells. Where this reduction becomes appreciable it can usually be overcome by increasing the generator voltage. Do not be surprised, therefore, if the voltage of the cells comes up very much higher in winter than in summer for the same condition of charge.

The specific gravity readings of the electrolyte behave somewhat like the voltage. For a given state of charge, the specific gravity readings will be higher when the electrolyte is cold than when warm. Thus it will be found that with proper charging the readings reached at the end of charge will gradually increase as the temperature falls in winter and decrease in summer, this phenomenon being perfectly normal.

Finally there is a very large percentage of batteries, isolated plants, vehicles, cells and ignition batteries which are only used during the summer for three or four months, and remain idle during the rest of the year. In such cases the best method is to give the battery a good gassing charge about once a month, adding sufficient water to replace the evaporation and keep the plates covered. If this is not convenient and the period of idleness is not over nine months, the battery should be given a thorough charge, continuing until absolutely sure that the voltage and sp. gr. readings will not rise any higher, and then the battery can be disconnected at its terminals and allowed to stand without any further charging. During the charge and when the cells are gassing, as much water should be added to them as they will take without overflowing. Should the evaporation during the idle period, which, as already stated, must not exceed nine months, be so great that the level of the electrolyte falls below the tops of the plates, sufficient water must be added to keep them covered; and in this case, unless the battery can be charged it will be necessary to stir the electrolyte and water mechanically in order to prevent freezing. After such a stand, the battery will require a thorough overcharge before it is ready for service.

In the comparatively rare cases where it is desired to take plants out of commission for more than nine months, and charging cannot be provided for, the only safe plan is to take the cells out of commission by allowing the plates to dry. In the case of glass jar batteries, the cells are given a thorough charge, and the electrolyte is drawn off and stored in suitable vessels, preferably carboys. The cells are then filled with pure water and allowed to stand for some fifteen hours, when the water is drawn off and the plates are allowed to dry. Sometimes the negative plates show a tendency to heating during the process of drying and in this case they should be sprinkled with water in order to keep them cool. After drying, the plates will stand indefinitely without any attention, but require a complete initial charge before they are again ready for service. When the cells are equipped with wooden separators these should be removed, before allowing the plates to dry, and thrown away.

In the case of portable cells, or those set up in rubber jars, it is necessary to remove the plates from the jars and separate them before drying. After drying, the negatives should be allowed to soak in electrolyte for three or four hours and again rinsed, when they are ready for final drying and storage.

It is hoped that the above suggestions will cover the average cases which battery users are likely to encounter, but it cannot be emphasized too strongly that where special conditions come up which are not understood, the only safe plan is to consult the manufacturer before going ahead. A battery requires comparatively little attention, but, on the other hand improper handling may cause serious damage.

Jovian Notes

Morgan P. Ellis, sales manager of the Benjamin Electric & Manufacturing Co., Ltd., has been appointed Statesman at Large of the Sons of Jove during the period of the new reigning Jupiter Frank Watt.

On Nov. 15th at a meeting of the Sons of Jove at the Engineers Club, presided over by Mr. Parker H. Kemble, Statesman for Ontario, an address was given by Mr. E. L. Cousins, engineer of the Toronto Harbor Commission.

The Jovians of Toronto are having weekly luncheons this winter, which are held every Friday at the Woodbine Hotel. These luncheons are well attended. Arrangements are being made to hold a Rejuvenation about the 20th of January, the exact date of which has not been settled at the time of going to press.

The Modern Steam Turbine

Up to the year 1895 the turbine idea had not been applied to machinery operated by steam. In that year Parsons' steam engine was first introduced and since that time with improvements and developments in construction, the application of steam turbines has been the means of revolutionizing steam engine operation the world over. Roughly speaking, there are two general classes of steam turbines, those employing the reaction principle and those employing the impulse principle.

In the reaction type of turbine approximately one-half of the expansion in any one stage takes place in the stationary blades imparting to the steam a velocity substantially equal to that of the moving blades so that it enters them without impact. The remainder of the expansion takes place within the moving blades, the spaces between which gradually grow smaller from the inlet to the exit side of the turbine, forming a ring of moving nozzles. The velocity imparted to the steam by reason of the expansion within the moving blades produces a reactive force on these blades which turns the rotor of the turbine. This effect is very similar to the rotation produced by water issuing from an ordinary hose nozzle.

In the impulse type of turbine the complete expansion for any one stage takes place in the stationary blades or nozzles and the steam is delivered to the moving blades with a velocity somewhat more than double that of the blades. The passages between the moving blades are of uniform or even slightly increasing cross section from inlet to outlet. The moving blades check and reverse the velocity of the steam current and the reluctance of the steam current to alter its direction and velocity gives rise to a force against the blades which sets the rotor in motion.

In later practice a combination of these two principles is utilized in such a way that the advantages of both are made use of. The first stage of the expansion in the reaction turbine is the least efficient part of this machine. In the combination this is replaced by a single impulse element. The intermediate and low pressure sections are retained because in these the volume of the steam is sufficient to require reasonably long blades moving at considerable velocities, which experience shows to have a decided

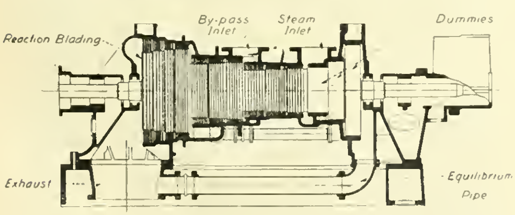

Fig. 1—Section Parsons type single-flow turbine

economic advantage over the impulse type at this stage. The use of the single impulse element also makes possible a shorter turbine and consequently a much stronger rotor.

In the all-impulse type the rotor is built up by discs mounted on a shaft of small diameter so that the circumferential clearance between the shaft and the diaphrams separating the pressure chambers may be as small as possible, in which case the considerable pressure drops between adjacent stages will not cause too much leakage. In the reaction type the pressure drops between adjacent stages are very much smaller and the body of the rotor is often built up in the form of a hollow drum which is a stiffer construction than the shaft and disc design and therefore so much safer. Illustrations of the different general types of steam turbine follow with brief descriptive matter in each case.

The Single Flow Type

Figure 1 illustrates the original single-flow Parsons type. Steam is admitted as shown to an annular chamber in the casing. From this point it passes alternately through rings of fixed and moving blades of increasing lengths on the small diameter of the drum or rotor, expanding in volume as it passes through the successive rings. When the volume of the steam has increased to the extent that

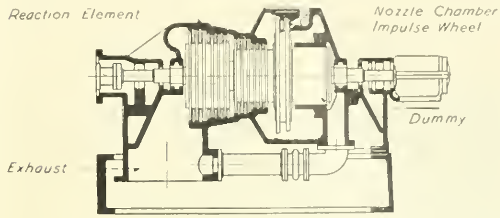

Fig. 2—Combination Impulse and Reaction type

the blades on the smallest diameter of the drum and casing would have to be inconveniently long to provide outlet for it at a sufficiently low velocity, the diameters of the drum and casing are increased for the next stage of the expansion. When the blades in the second stage reach a certain length the diameter is again increased.

The available area of the steam passage through the blades is an approximately constant percentage of the product of the mean circumference of the blade ring multiplied by the length of the blades. If the mean diameter of the blade ring in the second stage be increased to about 1.42, that is $\sqrt{2}$, times that of those in the first stage, the area through each blade ring per unit length of blade height will be 1.42 times that through the first stage of blade rings. Further, on account of the larger diameter the mean speed of the blades will also be 1.42 times that of the blades in the first stage and also on that account too the velocity of the steam through the blades in the second state would be 1.42 times that in the first stage. Now, if the area of the second blade ring per unit height of blade and the velocity of the steam through the blades are both 1.42 times as great as in the first stage and if the blade length remained the same in each case the quantity of steam that would pass through the second stage would be 1.42 x 1.42 or $\sqrt{2} \times \sqrt{2}$, i.e. 2, times as much as through the first stage. It follows, therefore, that to pass the same volume of steam per second through the blades in the second stage will only require these blades to be one-half as high as in the first stage.

As the steam expands in the second stage its volume increases until the blade heights again become excessive. The drum diameter is again increased therefore, and the blade heights of the enlarged diameter are reduced as before. Expansion again proceeds along the third stage through progressively increasing blade rings until the pressure of the steam falls to that of the atmosphere or the exhaust.

Impulse and Reaction Single-Flow Type

Fig. 2 illustrates a modification of the single flow design in which the smallest part of the drum of the reaction blading is replaced by a single impulse wheel. As already stated, this part of the reaction turbine is the least efficient of the three stages. The steam is admitted to the nozzle

block, is expanded in the nozzle, and then discharged against a portion of the periphery of the impulse wheel.

It will be seen from the drawing that the intermediate and low pressure stages are identical with the corresponding stages in the design shown in Fig. 1. It is not claimed that the substitution of the impulse element for the high pressure section of the reaction blading has any influence one way or the other on the efficiency. The design is attractive, however, in that it shortens the machine and gives a stiffer rotor.

The Double Flow Turbine

Fig. 3 shows a section of a double-flow type turbine. The capacity of a single-flow turbine is limited by the rotation speed. The economic velocity at which the steam may pass through the blades of the turbine depends on the velocity of the moving blades. The capacity of the turbine depends on the weight of the steam passed per unit of time, which in turn depends on the mean velocity and the height of the blades. For a given rotating speed the mean diameter of the blade ring is limited in practice by the allowable stresses due to centrifugal force. As a result there is a practical limit to the height of the blades.

If, therefore, the rotative speed is made only half as great, the maximum diameter of the rotor may be doubled and therefore the capacity of the turbine will be doubled without increasing the height of the blades. Just as with the single crank reciprocating engine so with the single-flow steam turbine there is a practical limiting economical capacity for any given speed. When this limit was reached with the single crank reciprocating engine a unit with double the power was produced by coupling two single crank engines to one shaft. In exactly the same way the power of the steam turbine was doubled by making a double-flow turbine, which is in effect, as will be seen from the figure, two single-flow turbines built up in a single rotor, in a single casing with one common inlet but with two exhausts. Steam enters the nozzle chamber as shown in the figure, acts first on the impulse element and then divides into two parts, one half going through the reaction blading at the left of the impulse wheel, the other half through the impulse blading at the right.

A modification of the double-flow turbine is shown in Fig. 4, in which both the high pressure reaction unit and the intermediate section of reaction blading is single-flow, the low pressure section only being double-flow. This would be analagous to a triple compound reciprocating engine with one high pressure, one intermediate pressure and

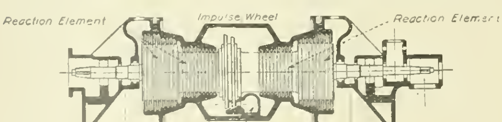

Fig. 3—Section of double-flow turbine

two low pressure cylinders—a not uncommon design. Such turbines are useful for capacities greater than is desirable for a single-flow turbine but which are still below the maximum possibilities of a double-flow turbine of the same speed. In such machines the best efficiency is secured by making the intermediate blading in a single section large enough to pass the entire quantity of steam.

Special Turbines

The turbine principle, in addition to the above applications, is sufficiently flexible as to be capable of other special adaptations. What are known as "low pressure" turbines use exhaust steam from non-condensing engines and are valuable as supplementing exhausting plants for increasing the capacity with a minimum outlay for new equipment. Theoretically the capacity can be more than doubled by the use of the low pressure steam from a non-condensing engine and even in practice results well up to this point have been secured. Another type known as "bleeder" turbines are designed for use in plants which are required to furnish not only power but also considerable and varying quantities of low pressure steam for heating purposes. In these turbines a part of the steam which has done work in the high pressure stages may be diverted to the heating system and a part extended through the low pressure blading of the

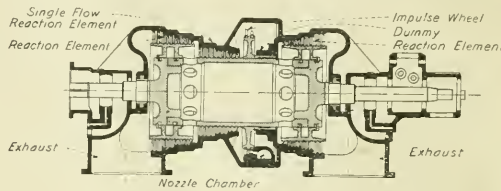

Fig. 4—Section of semi-double-flow turbine

bleeder turbine and exhausted into a condenser. In this way none of the energy of the heating system due to the difference of pressure between the boiler and the heating system is wasted. On the other hand if no steam is required for heating purposes the turbine uses all the low pressure steam and is claimed to operate as efficiently under these varying conditions as under a constant supply of steam.

The Ferranti Electrical Company of Canada, Limited

The Ferranti Electrical Company of Canada are now settled in their new home in the Lowes Building, 90 Sherbourne street, Toronto, where the general manager, Mr. Geo. C. Royce, reports business coming in briskly, with splendid prospects for the new year. The company is occupying two full floors in this large building, which are being fitted up in such a way as to facilitate business and give the customer the greatest possible information on the equipment he is purchasing. For example, switchboards will be set up as in a power house, equipped with all the necessary instruments. A very large stock of meters of the well-known Ferranti type will be carried at all times, the storage room being supplied with shelving for 5,000 meters. This company has been very happy in its choice of location on Sherbourne street, being such that out-of-town customers can drop off the Belt Line cars right at their doors.

Motor Equipment of Ontario Paper Co.

The Ontario Paper Company are pushing actively the work of construction on their large development at Thorold, Ont. This plant will be one of the largest of its type in the country when completed. Contracts have recently been awarded for the entire equipment, both mechanical and electrical. The motors for driving the grinders are being manufactured by the General Electric Company of Sweden and supplied through Messrs. Kilmer, Pullen & Burnham. There will be five large induction motors, each of 2,000 h.p., 11,000 volt, 3-phase, 25 cycle, 250 r.p.m. These will be direct connected to the grinder shafts by means of leather band flexible couplings supplied with the motors. It is hoped that the work will be sufficiently advanced for the plant to be put into operation early in the year 1913.

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New Auxiliary Steam Plant of W.E.R. Co.

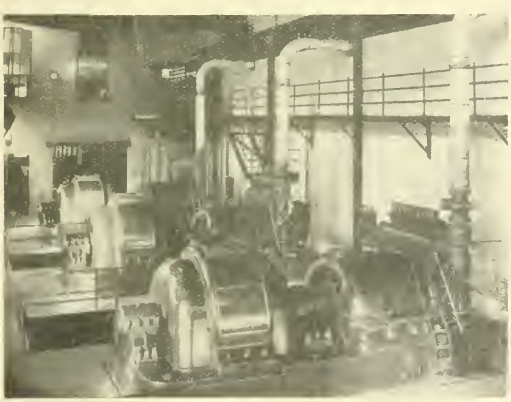
Stand-by Capacity Now 17,000 Kw. or Equal to the Present Hydro-Electric Output. Steam Turbines used with all Modern Labor Saving Auxiliaries

By Mr. E. A. Graham

It is becoming recognized more and more every day that hydro-electric plants, no matter how well built and operated, serve the public best when they are insured by a well equipped with efficient auxiliary plant, the size of which depends on the number of hydro-electric plants tied together, and their relative location to one another, that is, whether located on different water-sheds, or whether there is considerable diversity between these plants on the same stream. In the case of a single hydro-electric plant, the auxiliary plant should be of at least half its capacity and preferably greater than that, while in the case of a number of plants on the same or different watersheds where ice, floods or emergency conditions would not be likely to cripple more than one or two at a time, the capacity of the auxiliary plant should be at least that of any one of the plants, and under some conditions much larger.

The Winnipeg Electric Railway Company have met this problem by installing a steam turbine plant of a normal rating of 9,000 kw., continuous overload rating of 12,000 kw., which with their original steam plant of 5,000 kw. capacity, gives an available steam plant output of 17,000 kw. for a hydro-electric plant of 14,000 kw. normal rating, but which will easily carry a peak load of 24,000 kw. The power consumers of this company are therefore fully insured against any lengthy power interruptions. The use of steam turbines was finally decided on after a careful consideration of other prime movers available as offering the simplest, most reliable, and ultimately the most economical installation under the conditions of operation to be expected in Winnipeg.

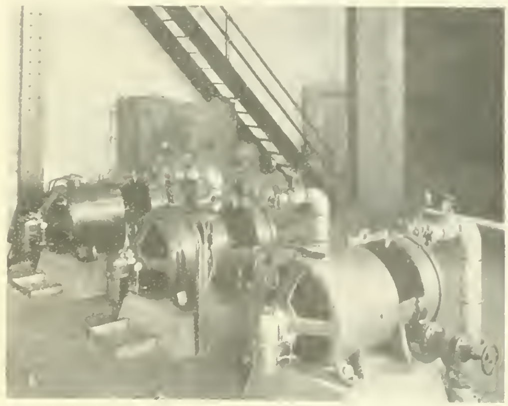
After the decision to build the plant was made late in January, 1911, the consulting engineers, Pratt & Ross, commenced the preparation of the plans, and coincident with the preparation of the plans, the work of excavating for the foundations, condensing water intake, etc., were carried on in early February, when the ground was well frozen. The most efficient method found for excavating this frozen ground was by means of a huge chisel connected to a pile driver hammer, and carried in leads in a travelling car.



Turbo-generators in new plant of W. E. R. Co.

This is an invention of Mr Wm Hurst, a Winnipeg contractor, and is very effective. The steam station is located in the rear of the terminal station for the transmission lines from Lac du Bonnet hydro-electric power plant, which is about three hundred feet from the Red River. It was necessary to go to this river for the water for the condensers and the make-up water for boilers.

The excavation of the pump pit for the circulating pumps and the conduit for condensing water proved the most difficult problem of the construction work of the plant. This pump pit is 19 feet wide by 50 feet long and the excavation was carried to a depth of 40 feet below the surface of the ground, all of which distance with the exception of the last three feet (a stiff blue clay) was through treacherous quicksand. The engineers used a very ingenious method of timbering, however, and made their excavation and put in their concrete with no mishaps whatever. From the bottom of the pump pit it was necessary to run a duplicate concrete conduit, one for the circulating pump intake, and the other for the condenser discharge, and this had also to be run through the quicksand. The difficulties were further aggravated by the fact that the conduit had to be driven under six railway transfer tracks in constant use. Each of these conduits is of 16 feet cross sectional area, and leads into an intake which extends out under the river a distance of 50 feet, where it is protected by a built-up screen of ½ in. by 2½-in. iron.

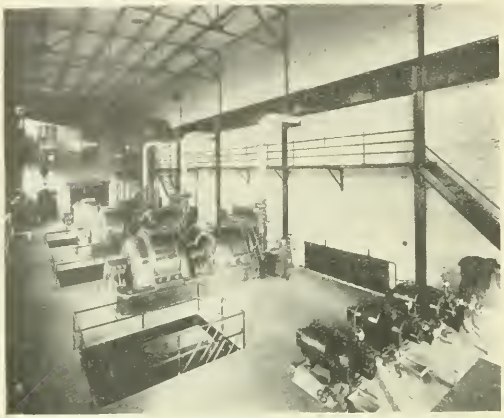


Turbo-exciters in W. E. R. Co's. new plant

On the river bank is a reinforced concrete screen house where the water again passes through screens which are of galvanized steel of ½-in. mesh. The intake from the river enters at two points, each controlled by sluice valves, so that it is possible to get at either for repair or cleaning. As before noted, the intake conduit is carried below the floor of the pump pit, and the suction connections are made directly to the pump through the concrete floor by an expansion sleeve which absorbs all vibrations from the pump. The pumps are located at such a level that even at the lowest stages of the river the shells are half full of water and as a

additional precaution in quick starting they can be primed by means of a connection from the hot well, or by suction from one of the vacuum pumps. Absolutely no seepage has been found to come in through the concrete walls or from the intake conduit connections.

The foundation proper for the building is of reinforced concrete on tamarack piles driven 45 feet to rock and cut off below the line of saturation and capped with concrete.



General view generators, exciters, switchboard &c.

Twisted bar reinforcement is used in walls, beams and columns, while the floors are of the arched type with Ferro-inclave reinforcing. The foundations for the turbines, which are of the horizontal type, are carried below the basement floor and do not touch the rest of the building, so that any vibration in the turbines is not so likely to be communicated to the floors and other parts of the building. The hot well is also of concrete, and the ash pits are lined with fire brick.

The superstructure is of steel construction tied in with steel superstructure of the sub-station adjoining. This structure has to carry the 45-ton crane and in the boiler room the 900-ton coal bin. The exterior walls and partition wall between boiler and turbine rooms are of local brick. The west wall of the turbine room and part of the boiler room is formed by the exterior wall of the Terminal Station, into which it opens through archways. The roof slab is also of concrete with Ferro-inclave reinforcing and, to avoid condensation on the under surface, a double roof is provided with an air space and a tar and gravel cover. This has proven very satisfactory under severe conditions. The windows are of Fenestra steel sash with wired glass and all doors are of the fireproof type. The over-all dimensions of the plant are 121 ft. 0 in. x 115 ft. 0 in.; the turbine room is 36 ft. 0 in. x 114 ft. and the boiler room 81 ft. 0 in. x 114 ft. 0 in.

Every precaution was taken to make the building and foundations safe and enduring, and in the selection of the apparatus for the interior of the plant, dependability was the essence of the contract, with all due regard for a high economy, necessary with fuel so expensive as it is in Winnipeg. There were therefore selected as will be noted below, Curtis horizontal steam turbines, Babcock and Wilcox boilers, Roney stokers, steam turbine driven exciters and circulating pumps, and feed pumps, and the highest grades of high pressure piping and fittings.

Coal and Ash Handling Equipment

In the West, the practice is to ship coal in box cars from the coal docks at the head of the Great Lakes, the box cars being used on the return trip for handling grain. This necessitates a different method for unloading than can be used in the East where dump bottom gondola cars are available. A motor driven Clark shovel, which in operation resembles a team driven scraper as much as anything else, is used for pulling the coal along the car floor to the door, whence it falls into the receiving hopper. This cuts down considerably the amount of manual labor needed for unloading a car. From the receiving hopper the coal is carried by a 30 inch apron feeding conveyor, 45 feet long at a speed of 30 ft. per min. to a Link Belt boiler house crusher with hard iron rolls 24 in. diameter by 24 in. face. These will break run-of-mine coal to 1¼ in. cubes and smaller, and will by-pass fine coal around the rolls. This is driven by a 15 h.p., 220 volt, three phase motor. The coal drops from the crusher into a Peck over-lapping pivotted bucket carrier, 114 feet long between horizontal centres, and 60 ft. vertically. This conveyor is motor operated with means for controlling its movement either from the crusher or from the conveyor motor up in the cupola. The crusher is located in the basement under the firing aisle between the boilers, and the conveyor runs up the wall at either end of the boiler room and dumps the coal into the bin, suspended directly over the firing aisle. A travelling dumper is provided so that the coal may be dumped at any place in the bin. The ashes are also handled by this conveyor, being raked from the ash pit into chutes emptying into the conveyor, and the stationary dumper at the top dumps the buckets into a chute which carries the ashes outside to a holder mounted over the railway siding. The capacity of the conveyor is 40 tons of bituminous coal received as run-of-mine or slack per hour. Ashes may also be handled at the same rate. The conveyor and crusher equipment were supplied and erected by the Link Belt Machinery Co.

The bin used for the coal storage is of the suspended type erected by the Brown Hoist Machinery Co., and is of reinforced concrete construction. Ribs of ½ in. x 4 in. steel are rivetted to special girders in the steel framework

Terminal station and auxiliary steam plant.

of the building, being allowed to take their natural curve (approximately that of a parabola) and to them are fastened the sheets of Ferro-inclave reinforcing, on both sides of which is plastered a thick coat of cement. Metal chutes with chain operated gates carry the coal to the stokers. The working of the entire coal handling equipment is characterized by a comparative freedom from the noise found in other plants.

There are installed at present ten Babcock and Wilcox

water tube boilers set in two rows. The boilers are set separately with a passageway between them, and they each require a space of 23 ft. 6 in. x 15 ft. 5 in.

This method of setting, while requiring a little more room, is to be preferred for wide boilers, such as are used in this plant, on account of the improved facilities for cleaning and inspection. The boilers have a nominal rating of 651.5 h.p. and have a heating surface of 6515 sq. ft. Each boiler comprises 21 sections each with 14 tubes, 4 in. diameter and 18 ft. long expanded into wrought steel staggered headers, and three steam and water drums each 42 in. diameter and 24 ft. 7 in. long. A mud drum at the back of the boilers is provided with hand holes and two blow-off connections running into a main which discharges into the overflow at the gate house. The boilers are for operation at 200 lbs. pressure and are tested to 300 lbs. They are guaranteed to evaporate 30,500 lbs. of steam per hour from and at 212 deg. F. Each boiler is provided with six pop safety valves 2½ in. diameter. One of the accompanying illustrations gives some idea as to the arrangement of the boilers, stokers, etc. It is quite difficult to get a photograph that will do this part of plant full justice. For stoking the boilers there are provided ten New Model Roney stokers, manufactured by the Westinghouse Machine Co. These stokers are provided with removable fuel plates.

With fuel of 14,000 B.t.u. content, stokers are supposed to develop 150 per cent. of full rated capacity of boiler, based on 10 sq. ft. of effective heating surface per h.p. with a draft of ½ in. of water. At or near their rating, stokers are capable of causing the evaporation of 10.2 lbs. of water per lb. of dry coal. There are 127 feet of grate surface, giving a ratio of 1 ft. of grate surface to about 51 ft. heating surface. This type of stoker was adopted on account of its flexibility in picking up and handling emergency loads, and on such loads, both boiler and stoker have given good results. The stokers are driven by four Westinghouse vertical stoker engines, operated at 100 lb. steam pressure.

The superheaters are of the Foster patent corrugated type, and will deliver to the turbines, 22,476 lbs. of steam per hour at 200 lbs. pressure, 125 deg. superheat.

The feed pumps, of which there are three, are four stage Mather and Platt turbine pumps with phosphor-bronze impellers and guide tips, and are direct-connected to 50 B.h.p. non-condensing single-stage horizontal Curtis steam turbines, running at 2500 r.p.m. Each of these pumps is capable of delivering 130,000 lbs. of water per hour for 3 hrs. overload, and 89,000 lbs. of water at normal load against a pressure of 200 lbs. The suction pipe is 5 in. in dia. and the discharge end 4 in. When in service they are run constantly, the governors admitting only sufficient steam to keep the set up to speed, water being pumped into the boilers directly the valves are opened. The feed pumps are located in an annex to the boiler room on the basement level and are very accessible to the attendants.

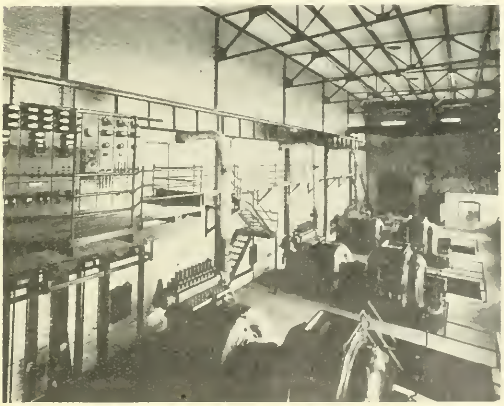
The smoke and waste gases discharge directly from the back of the boilers into sheet steel breechings, the draft being hand-regulated by butterfly valves on ball bearing shafts. These breechings run the length of the boiler room and on either side, and discharge the gas into a Kellogg reinforced concrete chimney. This chimney which is the largest in Canada, was erected at the rate of six feet per day, which is excellent time considering the materials to be handled. It is 256 feet high, 24 ft. in diameter at the bottom, and 14 ft. in diameter at the top The thickness of the wall varies from 11 in. at the bottom to 6 in. at the top and there is a uniform taper of 1 inch in 25 ft. The foundation, which is a reinforced concrete matt 35 ft. square and 6 ft. deep, rests on 169-45 ft. tamarack piles spaced 2 ft. 9 in. on centres. The vertical reinforcing is iron bars bent at right angles to tie into the foundation reinforcing, and tied in with No. 23 wire mesh for circular reinforcement There is a lining of fire brick for a distance of about 50 feet above the flue openings, the two breechings are separated by a baffle wall 9 in. thick and there is a concrete floor 2 ft. below flue openings. Pyrometer and draft gauge connections are provided.

The chimney is provided with an outside ladder and ample protection in the way of lightning rods, there being eight ¾ in. copper points tipped with 1½ in. solid platinum, and connected to a large copper ground plate by a No. 4/0 cable.

Piping

As the bus bars, oil switches and connections are to the electric plant, so the piping and valves are to the steam plant, and a failure anywhere is liable to be fatal unless proper provision is made for the isolation of sections in trouble without crippling the remainder of the plant by so doing. In this plant, the 7 in. connections from each boiler pass through valves into an 8 in. loop main, which is however enlarged to a 10-in. header on the side nearest the turbine connections. There is also an 8 in. cross connection along the ceiling of the boiler room from one side of loop to the other, and the main is sectionalized by hydraulicly operated gate valves so placed that not more than three boilers can be cut out by trouble at any place. These valves are operated by force pumps located on the boiler room floor.

The steam and water mains to the feed pumps are in duplicate so that two pumps are always available for use.



Nearer view of switchboard, W.E.R. Co's. auxiliary plant

The feed water connections to the boilers are also in duplicate. As all of the auxiliaries are non condensing, their exhaust steam is piped to the two Worthington high pressure closed vertical heaters, each of which has a heating surface of 450 sq. ft. in ¾ in. tube , and a capacity of 89,000 lbs. of water per hour from 80 to not less than 205 deg. F. when supplied with not less than 8500 lbs. of exhaust steam per hour at atmosphere. These were supplied by the Alberger Condenser Co.

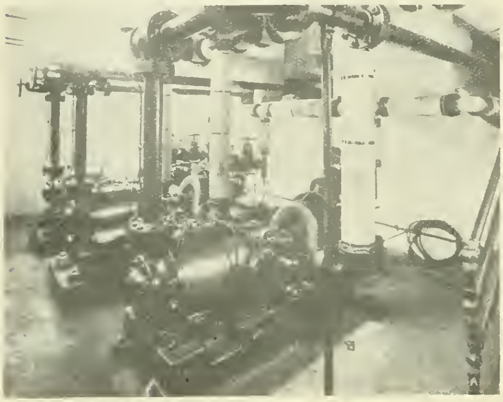
The steam line is effectively drained at various points by pipes leading to Bundy tank traps, returning the water to the hot well. The high pressure piping was supplied by the Babcock and Wilcox Co. and the high pressure valves by them and by the Crane Co., who also supplied a large part of the low pressure piping.

In addition to the hot well with its duplicate tanks,

there is an L. R. Booth water softening plant of 4000 gallons per hour capacity installed alongside the hot well.

Turbo-Generators and Auxiliaries

The generating equipment consists of three six stage horizontal Curtis steam turbines direct coupled to 3000 kw., three phase, 60 cycle, 1800 r.p.m. alternators. These sets have a continuous overload rating of 4000 kw. The speed regulation of the turbines is 2½ per cent. for ranges, in load, from full load to no load, and the generator regulation under the same conditions is 14 per cent. The generators are intended for use with Tirrill regulators. The turbine governors are hydraulicly operated, using oil under 100 lbs. pressure, while the circulating oil for the bearings is under about 25 lbs. pressure. The bearings are still further cooled by water coils imbedded in the babbitt. The generators are entirely enclosed, save for the air intake at the bottom and the outlet at the top of the generator frame. Carefully screened air is brought in from outside the building through a well lagged metal duct. 18,000 cu. ft. of air per minute at 65 deg. F. is required for cooling a generator at maximum load conditions. The guaranteed steam consumption for 3000 kw. output at 200 lbs. pressure and 125 deg. superheat and 2 in. absolute vacuum is 11 lbs. of steam per h.p. hr. They each require a floor space of 24 ft. 5 in. by 10 ft. 0 in. and stand 8 ft. 5 in. high.



Turbine feed pumps, W.E.R. Co's. auxiliary plant

Excitation is furnished by three 50 kw., 3600 r.p.m., 125 volt interpole generators, direct coupled to single stage horizontal Curtis turbines.

The condensers are located in the basement with their main axes parallel to that of the turbo-generator, and the exhaust connections from the bottom of the turbine are made in the side of the condenser by a 48 in. elbow, from which there is a 24 in. Y connection and elbow up to a Cochrane automatic atmospheric relief valve for exhausting to the atmosphere in case of failure of vacuum. The exhaust connection is an 18 in. galvanized pipe with an 18 in. exhaust head on the roof.

The condensers are the Wheeler surface type with 9000 sq. ft. cooling surface in ¾ in. seamless drawn brass tubes. The shell is 7 ft. 2 in. in diameter and tubes are 10 ft. 2 in. long. The vacuum is maintained by three Mullin horizontal suction valveless double acting crank and fly wheel pumps. They run at a speed of 105 r.p.m. and develop about 21 h.p. each with 1100 lbs. of steam per hour. All of these pumps are connected to the same suction main so that a breakdown of one will in no way cripple the plant, for the remaining two will maintain the vacuum at maximum load conditions. These vacuum pumps may also be used to prime the circulating pumps. The vacuum pumps have to pump against a head of about ten feet into the hot well or softening plant.

The condensers are guaranteed to condense 72,000 lbs. of steam per hour at a vacuum of 2 in. absolute with 8000 gallons of circulating water per minute at 65 deg. F. As before noted the circulating water pumps are at the bottom of the sub-basement. There are three of these, each of the horizontal volute type 18 in. turbine pumps built by the I. P. Morris Co. The impellers are of bronze composition and specially designed throughout for operation at high speeds. They are provided with ring oiling bearings and water sealed stuffing boxes on shafts. The suction chamber of each is on the lower side of the case, and the discharge to the circulating water main is at the top. The pumps are direct coupled to 100 h.p. 24 in., 8 stage, 900 r.p.m. Kerr turbines. There is also in this pit a duplex pump with 4 in. discharge which is normally used for emptying drainage sump, but which may be used for priming circulating pumps, for pumping water to flush out boilers, or for supplying make-up water.

All of the principal auxiliaries are of sufficient capacity for any two to serve the plant when running at full rated output, leaving a third for a spare, and it will also be noted that they are all of the turbine type except the air pumps.

Switchboard

In keeping with the remainder of the equipment, the switchboard is as simple and free from complications as is consistent with safe operation. It is mounted on a gallery above the turbine floor, and on a level with the switchboard floor of the main distributing sub-station, to which there is access through a large archway. The switchboard is of natural black slate finish and comprises a total load panel, three turbo-generator panels, Tirrill regulator panel, and three exciter panels. On the total load panel there is at present ammeters showing the total load delivered by the steam plant, and the ampere load on the transmission lines from Lac du Bonnet.

On the generator panels are the a.c. ammeters, power factor meter, field ammeter, indicating wattmeter, integrating watthour meter, a.c. voltmeter, and the necessary control switches and indicating lamps for the electrically controlled field switches, main oil switches, field rheostat, and turbine governor control motor, so that the operator has complete control of the machines and switching with the fewest possible motions. The generators are paralleled with the

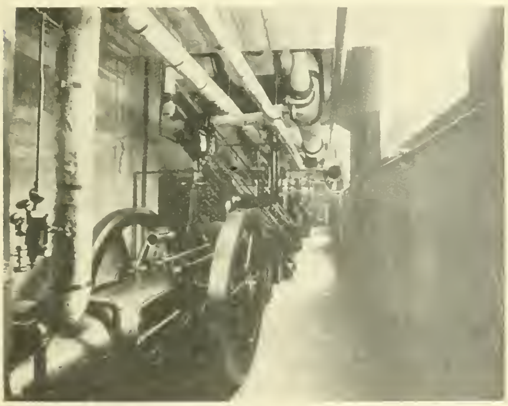
Boiler room, W.E.R. auxiliary plant

2200 volt bus-bars of the terminal station through oil circuit breakers in a switch room adjoining the switchboard. As this room is at the extreme end of the sub-station bus-bars and it was impossible to increase their capacity, a new set of bus-bars was built from these switches to the bus tie switch of the old structure, where they may be connected, by disconnecting switches, to either side of this bus tie switch.

The generators are protected by reverse current relays and over-load inverse time limit relays. Instead of tripping out the oil switches, however, these relays close a loud ringing gong relay which calls the operators attention to the trouble. Ordinarily when operating in parallel with Lac du Bonnet, the Tirrill regulator at that station regulates the voltage, and its governors are set so that they take most of the peaks. As a consequence, the voltage curve in the sub-station is very even. The extensive use of synchronous motor-generator sets on the system gives a load on the transmission line of very high power-factor, and the regulation is therefore very good.

Station Lighting

One hundred watt tungsten lamps are used quite generally for lighting, being mounted on the roof trusses of the turbine room with intensifying shades and giving a very uniform and satisfactory light. Their maintenance is very low. In front of the switchboard it may be noted that an eight foot "Lin-o-lite" is mounted on pipes which are a part of the railing. This gives a very satisfactory light,



Reciprocating vacuum pumps, W.E.R. Co's. auxiliary plant

it being uniformly distributed on the board and there is no glare in the floorman's eyes when watching for signals from the operator. An intercommunicating telephone system is used to connect the various important parts of the two stations.

Work on the plans for this plant was first commenced in January 1911, and the first unit of the plant was put in operation Dec. 23, 1911. The excellent time made in the erection of the plant may best be appreciated by those who are familiar with the extremely severe climatic conditions existing in the early spring and late fall in Winnipeg, and the difficulty experienced in securing delivery of material on so short notice. The plant has been pronounced by one of the most eminent electrical engineers on the continent as being the best designed and most economical stand-by plant he has inspected.

The consulting engineers were Messrs. Pratt & Ross, and H. Edwards of Winnipeg, under whose direction all of the work of construction was carried on. In the elaboration of the design, details of construction and operation were carefully worked out in conjunction with the officials of the Winnipeg Electric Railway Company, Mr. Wilford Phillips, manager, Mr. Wilson Phillips, general superintendent, and Mr. C. R. Ross, electrical engineer.

Personals

Mr. W. K. Jeffrey, manager of the Ottawa Car Co., is making an extended western trip through to the coast.

Mr. J. F. B. Vandeleur has resumed business in the Dineen Building in electrical supplies, as originally carried on by him.

Mr. W. E. Skinner, of the W. E. Skinner Company, Limited, has gone south again this winter on account of ill-health.

Mr. Jno. W. Moyes has been engaged by the Toronto city council to prepare a report on a suburban railway service.

Mr. G. C. Burnham of the firm of Kilmer, Pullen and Burnham is in Sweden in connection with the business of his firm.

Mr. W. F. Kelly, formerly chief of the Ontario sales department of the Canadian Tungsten Lamp Co., has been transferred, temporarily at least, to British Columbia.

Mr. G. A. McNamee, for several years assistant secretary-treasurer of the Montreal Tramways Company, has resigned. Before leaving he was presented by Mr. Dubee, on behalf of the staff, with a very handsome clock.

Mr. C. F. Beames, general manager of the Nipissing Central Railway Company, previous to its purchase by the government to form part of the T. & N. O. railway system, is now chief electrical engineer to the Government of Mysore, India.

Mr. H. C. Barber, up to the present time assistant chief engineer to the municipal hydro-electric system in Hamilton, Ont., has been appointed assistant manager of the Toronto Hydro-electric System and assumes his new duties on January 1st.

Mr. W. C. Freeman has resigned his position as manager of the Ontario branch of the Stromberg-Carlson Telephone Company and accepted a similar position, with headquarters in Toronto, with the Century Telephone Construction Company of Buffalo and Bridgeburg.

Mr. E. S. Cook, formerly of the Westinghouse Electric & Mfg. Co., has been engaged by the Canadian Tungsten Lamp Co., of Hamilton to look after their interests throughout the province of Ontario. He is now busily engaged drumming up trade and reports splendid prospects.

Mr. Gordon Kribs, a '05 graduate of the Faculty of Applied Science of the University of Toronto, formerly in the electrical department of Smith, Kerry & Chace, and later assistant to the chief engineer of the Pacific Power & Light Company, Portland, Ore., has been appointed assistant to the chief engineer of the Texas Power & Light Company, Dallas, Texas.

Dinner of University of Toronto Engineering Alumni

On December 17th the Engineering Alumni Association of the Faculty of Applied Science of the University of Toronto held their annual dinner, Mr. J. C. Armer presiding. The discussion dealt chiefly with the research work to be done by Messrs. Dobson and Shaw during the next year. As mentioned recently in the Electrical News, Mr. Dobson's work will deal particularly with the study of conditions on high tension transmission lines in which he will have the co-operation of the Ontario H. E. P. Commission.

Miscellaneous Cost Data

Installing Insulators

Putting 100 centre groove porcelain insulators on span wire to carry No. 10 T. B. W. P. iron telephone wire. A tower wagon with boxes on top was used for this purpose, putting two insulators on one span and tying each insulator to the 5/16-in. messenger wire with a tie of 8-in. No. 10 T. B. W. P. iron wire.

One foreman, 9 hours	$2.66
One lineman, 9 hours	2.50
One groundman, 9 hours	1.75
One team, 9 hours	4.00
Total	$10.91
Amount per span	.218
Amount per knob	.109

Shaving and Roofing Poles

5-in. x 20-ft. cedar telephone poles	$ .33
Add $ .04 for board of men	.04
Total	$ .37
6-in. to 7-in. x 30-ft. cedar trolley poles	$ .661
Add $ .022 for board of men	.022
Total	$ .683
7½-in. x 35-ft. cedar trolley poles, used at railroad crossings, total	$1.25

Painting

Painting 70 breasters (rough all over) 3-in. x 12-in. x 4-ft., No. 1 hemlock, with one coat of carbolineum avenarius.

One man, 5 hours at $ .19 4/9	$ .97
4 gal. preserver at $ .70	2.80
¾ gal. gasoline at .16	.12
Total	$3.89
Price per breaster	$ .056

Bonding

Four men, 25 compressed terminal bonds a day, 12½ joints, continuous rail joints, digging out joint, taking off joint, reaming 4 holes, putting in bonds, putting on plate,—cost each, $ .29.

Drawing Earth

Drawing dirt by means of wagons, each wagon holding over 1 cu. yd. Laborers wage equals $ .16 per hour, hire of team $ .40 per hour.

No. of loads	Total Cost	Distance	Cost per load
98 loads	$33.50	1100 ft.	$ .342
135 loads	46.60	1150 ft.	.345
146 loads	56.73	1000 ft.	.388
230 loads	63.76	800 ft.	.277
218 loads	71.73	800 ft.	.329
247 loads	75.69	700 ft.	.364
158 loads	51.43	550 ft.	.325
Average, 176 loads	57.06	871 ft.	$ .338

Distributing Ties

Distributing dry cedar ties (50 per station) on right-of-way. The gang consisted of three teams. Two teams were of a good standard type of draught teams, No.'s 2 and 3. No. 1 being about 85 per cent. of standard type. The wagons were 3-inch tire with flat platform top. The work first described was that of drawing a distance of 2¼ miles. ¾ of a mile of this was quite a deep sand and gravel. 1½ miles was generally level. Average condition of roads 90 per cent. of good. Ties taken from railroad freight car. Four trips made in one day.

No. 1 team delivered 220 ties at 2¼c each	$4.95
No. 2 team delivered 240 ties at 2¼c each	5.40
No. 3 team delivered 240 ties at 2¼c each	5.40
Total, 700 ties	$15.75

Another day, same teams and wagons, roads better, smooth and frozen, distance 3¼ miles. Ties taken from car, 8-ft. dry cedar ties.

No. 1 team drew 3 lds. (60 ties ea.) 180 ties at 2¼c. ea.	$4.05
No. 2 team drew 3 lds. (65 ties ea.) 195 ties at 2¼c. ea.	4.29
No. 3 team drew 3 lds. (65 ties ea.) 195 ties at 2¼c. ea.	4.29
Total, 570 ties	$12.63

Conditions same as above, excepting the length of ties being 9 feet; taken from pile; distance, 3¾ miles.

No. 1 team drew 3 lds. (55 ties ea.) 165 ties at 2¼c ea.	$3.71
No. 2 team drew 3 lds. (60 ties ea.) 180 ties at 2¼c. ea.	4.05
No. 3 team drew 3 lds. (60 ties ea.) 180 ties at 2¼c. ea.	4.05
Total, 525 ties	$11.81

Same three teams drawing 8-ft. dry cedar ties, distance 1 mile, medium condition of roads, ties taken from car.

No. 1 team drew 5 lds. (55 ties ea.) 275 ties at 2¼c. ea.	$6.19
No. 2 team drew 5 lds. (60 ties ea.) 300 ties at 2¼c. ea.	6.75
No. 3 team drew 5 lds. (60 ties ea.) 300 ties at 2¼c. ea.	6.75
Total, 875 ties	$19.69

Grubbing Trees

A certain swamp oak, 32-in. diameter, having a very heavy limby, spreading top and a height of 35 feet, growing in the open, in a water sag on a black loam and muck soil and blue clay subsoil; to grub out and trim, required 3 good men, 10 hours each, total 30 hours, at $1.75 per day, $5.25.

Unloading Tie Plates

Four Italians spent a total of 23 hours labor to unload from two box cars, 2,645 bales of tie plates, each bale contained 10 plates and weighing an average of 46 pounds; average work per hour, 115 bales. The bales were thrown from car door into a pile by side of the track. Total cost at $1.75 per day, $4.03.

Applying Bonds

Cost of applying ⅞-in. semi-plastic brown alloy bonds on grooved rail. A vertical electric drill, drilling a hole through the groove of the rail into the fish plate, was used and an average of 50 bonds were installed in a working day of ten hours. The rate of wages was as follows:

Foreman, $2.50 per day	$2.50
Four laborers, each $1.50 per day	6.00
Power	1.50
Total	$10.00
Cost of labor, superintendence and power, $ .20 per bond.	
Cost of bond, delivered	.42
Total cost, per bond applied	.62

The Ontario Railway and Municipal Board have ordered two extensions to the Toronto Suburban car lines in West Toronto, now known as Ward 7. The total length of the two lines is slightly over two miles. The order calls for a single track laid a little to one side of the centre line, so as to allow of double tracking when the traffic warrants it.

Canada's Prosperous Prairie Province

The Situation in Moose Jaw—A Most Modern and Complete Powerhouse and Plant.

The following extracts taken from the report of the Electrical Department for the city of Moose Jaw, for ten months ending October 31, 1912, are indicative of the phenomenal recuperative powers evidenced to-day in Canada from coast to coast. Destroyed by fire May 25, in full swing 65 days later and with entire deficit wiped out in seven months, is a record any city may well be proud of:—

Owing to the increase in the number of consumers during the years 1910 and 1911, of 114 per cent. an increase of current sold during the same period of 169 per cent., and the increase of peak load of 125 per cent., the first problem that faced the 1912 council regarding the Electrical Department was the increasing of the capacity of the plant. After thorough consideration it was decided to raise by by-laws the sum of $225,000 for this purpose, $113,000 of which was to be used for extensions to the power plant and the balance for line extensions, street lighting, meters, transformers, etc. Accordingly plans and specifications for the new equipment, buildings, and material were prepared and contracts awarded, the principal among which were as follows: Babcock & Wilcox Co. (boilers and stokers) $26,400; Canadian General Electric Co. (turbo-generator) $28,700; B. F. Sturtevant Co. (economizer and draft equipment) $10,300; Babcock & Wilcox Co. (coal and ash handling equipment) $9,500; Dawson & Co. (line material); James Stuart Electric Co. (line material); Eugene Phillips (copper wire); Johns-Manville Co. (lamp standards).

When plans were all in readiness and work was about to be started on the extension to the building, the old plant was destroyed by fire (May 25th) and all the plans rendered useless. When this occurred the situation was very serious indeed. The water works department were without power to operate pumps; industrial concerns operating on electric power were obliged to shut down, at least until some temporary arrangements were made; the streets were in darkness, and all residences without lights.

Only Three Hours Delay

Within three hours of the starting of the fire steps were being taken to restore service to water and light consumers and to furnish fire protection. A steam pump was obtained from the Robin Hood Mills and within sixty hours of the time the fire started, this pump was installed, the boilers got into operation again and the supply of water restored. In the meantime the telegraph wires were in search of electrical machinery either new or second hand and of any type. After waiting several days and receiving several propositions, it was decided to accept one from the Canadian General Electric Co. which was to supply a new three-phase outfit on the contract previously awarded them for a two-phase machine. This machine was shipped within ten days from Lynn, Mass., and in about sixty-five days from the date of the fire was put into operation on its permanent foundation in the new plant. During this interval a 150 kw. machine had been fitted up by the Robin Hood Mills and was giving a very limited service to power consumers. Also during the interval plans had been prepared for an entirely new building and plant, and contracts awarded. The debris had been cleared away and excavations and foundations started. Owing to the necessity of operating the plant during building operations, and the liability of large extras and trouble with the contractor it was decided to do this work by day labor. Work was commenced on clearing the debris and excavating for the new building on June 14th. The plans approved by council comprised an engine room 86 ft. x 50 ft. with 32 ft. walls and 10 ft. basement; boiler room 100 ft. x 86 ft. separated from engine room by a fire wall; pumping station and offices, and dressing rooms in a separate building 40 ft. x 60 ft., all to be of brick and steel construction, and fireproof. The new buildings were laid out to suit the location of the old boilers, thus permitting them to be operated during construction.

The buildings were also laid out to accommodate all the latest fuel and labor saving devices and a plant sufficient for a capacity of 3000 kilowatts or three times the present requirements. In addition to this the entire plant and buildings are designed for an extension which will give an ultimate capacity of 9000 kilowatts.

Provision is also made for coal and ash handling apparatus and other labor saving devices which when completed will reduce the pay roll by about $25 daily. Overhead coal bunkers are provided with capacity of 600 tons; also an ash bunker of 30 tons capacity, and a track hopper into which coal can be dumped direct from railway cars. In laying out the plant every precaution has been taken to make it convenient and capable of constant operation without interruption.

Local Firm Supplied Steel

The construction of the building called for a large amount of structural steel. As soon as possible tenders were called for this and only three were received. The earliest shipment offered was four months which would have been November 15th. Negotiations were entered into with the local Bridge & Iron Works and the contract awarded to them on a basis of cost plus 10 per cent. They guaranteed the cost not to exceed the amount of the highest tender and were given the privilege of substituting stock material for that called for on the plans, if necessary to get rapid delivery. By this arrangement sufficient steel to allow building operations to proceed was delivered on the site in less than one month. Building operations were later delayed at different times awaiting the delivery of structural steel. Scarcity of labor has been quite a handicap, but greatest delays have been on account of the slow deliveries of material.

Previous to the fire the system of generation and distribution was what is known as two phase. It was decided to change the system to three phase, which does not require such expensive lines and is generally recognized as the standard of the present time. Some of the power consumers have been caused some inconvenience by this change but it is expected that this trouble will soon be overcome satisfactorily to all concerned.

The fire also destroyed all the station equipments for arc lighting, the value of which was about equal to the lamps themselves. Advantage was taken of this, to install a much more efficient and modern system of street lighting. Instead of purchasing new station equipment for the old type lamps, the old lamps were discarded entirely and in future the city streets will be illuminated by metallic flame arc lamps which give about five times the illumination of the old carbon arc lamps with the same amount of current consumed. Early in the year it was decided to install about ninety additional street lights. Owing to the incomplete condition of the power house and the lack of accommodations for station equipment these lamps have not been added as yet but will be very shortly and when this is done every portion of the city will be extra well lighted.

Early in the year 1912 it was decided to change the

system proposed for the main street to tungsten clusters. This system is now installed. The ornamental lighting on side streets will be ready for operation by the time the power house is in condition to handle this load which will be before the new year.

Regarding line extensions, this work was very late getting started, as most of our poles, wire, and other line material which was ordered in March for delivery in May, did not arrive until the month of August. However since that time this work has been rushed as much as possible and at the present time there are only two or three extensions to build to serve all the houses for which connection has been applied for. There is still a large amount of rebuilding of lines to do to provide for a very large increase of business connected to them. This cannot all be done this year and it is probable that some of the most remote districts will have rather dim lights during the evening hours of this winter. As much of this work will be done as the weather will permit. Good linemen have been very hard to secure and retain during the last summer. A great deal of extra line work was made necessary by changing the system from two phase to three phase. This change had also to be made in a very short time and the work was carried out in a very creditable manner.

The operation of the plant, particularly since the month of July while building operations were being carried on at the same time, has been carried out with great difficulty. To allow the building to proceed and keep the plant in operation at the same time has necessitated all kinds of shifts being made, and this has been done at a cost of thousands of dollars.

Good Financial Statement

At this time last year our boilers were overloaded. At the present time these same boilers are handling over 50 per cent. additional load and doing this without the assistance of condensers which increases the demand for steam by about 30 per cent. During the peak load hours these boilers are working over 100 per cent. above their rated capacity and there is no opportunity to clean them as we have no spare capacity. With boilers operating under these conditions the efficiency is extremely low, and with our steam turbine still operating non-condensing the steam consumption is double, and on lights loads treble, what it would be running under normal conditions. In spite of these facts however you will note by the financial statement that this department shows a deficit of only $6,578.31 which will be entirely wiped out and converted into a surplus by the close of the year. It should be remembered that during ten weeks of the ten months covered by this statement that no revenue whatever was derived from the city plant. This is a very good indication that the action of last years' council in reducing the light rates one cent per kilowatt hour and the power rates to the equivalent of hydro-electric rates in the province of Ontarió was not based on guesswork. The rates given in this city are remarkably low when it is taken into consideration that the freight charges on fuel alone are equal to the total cost of a better grade of fuel delivered to steam plants in Ontario and Quebec. Had there been no interruption to the operation of the plant this year it is quite certain that a handsome surplus would have been shown. With the new plant in operation next year the cost of generation will be reduced by at least 15 per cent. and if present rates are not reduced and the increase of business continues at the present rapid rates, the electrical department will be a very considerable source of revenue for the year of 1913.

Owing to the destruction by fire of our total output, meters and other records, the department has lost some very valuable information, regarding losses in transmission, cost of generating per kw. hour, and an analysis of this cost. This information is very valuable in figuring on reduction of rates or quoting special rates to large consumers.

The current sold during the ten months (which was really only seven and one-half months) shows an increase over the same ten months of 1911 of 49.5 per cent. This does not take into consideration the fact that since May 1912 there has been very little street lighting done, the current for which was included in the figures of 1911. The increase of the number of consumers for the first ten months of 1912 was 980 or 49.7 per cent. as against 35.8 per cent. for the same period of 1911.

The gross revenue for this period of 1912 was $100,657.26 as against $78,881.64 for the same period of 1911, an increase of 27.6 per cent., and this increase was made with rates averaging about 15 per cent. lower than in 1911.

The total operating expenses for this period of 1912 were $107,235.57 as against $71,562.84, an increase of 50 per cent. over the same period of 1911. The reason for the large portion of this increase has already been given. From the figures of previous years, with the increase of business experienced this year the operating expenses would not have increased more than 30 per cent. under normal conditions over the same period of last year. Figuring on this basis had the plant been operating under normal conditions during the period covered by this report the financial statement would have shown a surplus of over $21,000.

Winnipeg City Extending Plant

At a recent meeting in Winnipeg of Messrs. Herdt and Kennedy, consulting engineers for the city of Winnipeg's hydro-electric development, the matter of a steam stand-by plant was carefully considered. It was decided not to build such a stand-by plant at present, but instead to commence immediately on designs and construction of a two circuit 110,000 volt transmission line from the power plant at Point du Bois to the city paralleling the present line on the opposite side of the right of way now occupied by a two circuit 60,000 volt line. The reason for the increased voltage of 110,000 is that it will require that voltage to transmit the amount of power remaining undeveloped at their present site, when it is all utilized. Steel towers with concrete footings and suspended insulators will be used. The footings will be put in during 1913 and the line will be ready for service, it is expected, by November 1, 1914. It is not intended to operate the line at 110,000 volts until the power plant building is extended to its final size, which it is expected will be in 1915. For the present it will be operated at 60,000 volts, and the switching at the generating end will be done at an outdoor station located across the tail-race from the power house. There will be added during the coming year two new hydraulic generating units of 6500 h.p. each with switching equipment, and transforming capacity of 9000 kw., which at the generating station will comprise one 9000 kw., 3 phase unit, and at the receiving station, three 3000 kw. single phase transformers.

In the city, the increased load obliges the department to extend the McPhillips street sub-station, and the arc lighting sub-station at May street, and the down-town station on King street. In addition to these extensions there will also be erected a new sub-station in Fort Rouge district which will be served by a duplicate underground 13000 volt feeder. Appropriations of $250,000 for new hydraulic and sub-station equipment and of $700,000 for the transmission line have been made.

A proposal was made by the W. E. Skinner Company, Limited, who are promoting a Central Steam Heating Company, to supply the city with a breakdown service of 10,000 kw., from low pressure turbines. The consulting engineers, while recognizing the merits of the proposition did not make any definite recommendations for the city to partici-

pate in the offer, but were emphatic in advising an immediate start on the transmission line

Collecting Data on Water Powers

The Prairie Provinces' water-powers upon which fairly definite information is available are mostly all confined to the southern portion of the provinces. This is a rather unfortunate coincidence and is likely to mislead the uninitiated regarding the total potentialities of these provinces, as the larger water-powers are situated in the north, on the Athabaska, Peace, Slave, Churchill, Nelson and other rivers. As even a preliminary survey of these rivers will be of great value, the Commission of Conservation has undertaken this work. During the last two summers, its Hydro-Electric Engineer, Mr. L. G. Denis, has been in the field making measurements of flow, height of falls, etc. Last year, the many rapids of the Athabaska river were investigated and the flow of the Peace and other rivers was measured. This year, the work included many long miles of travel, mostly by canoe, the western limit of the trip being the Peace River canyon in the north-eastern portion of British Columbia, while the northern limit was Fort Smith, on the Slave river. On the return trip the several rapids and falls in the Clearwater river and the upper waters of the Churchill were investigated. The general impression created by these large northern water-powers is that they will undoubtedly become of great value in connection with the wood-pulp industry. The raw material is close at hand, the only retarding factor, at present, being the lack of means of transportation and access. The details obtained by these investigations will be included in the Commission's forthcoming report on the "Water-Powers of Western Canada."

Kindersley, Sask.

The town of Kindersley, Sask., are at the present time installing electric generating and distributing equipment for supplying light and power. The plant will consist of a seventy-five kv.a., three phase, 60 cycle alternator, direct connected to a simple horizontal engine of 130 hp. capacity, at 277 r.p.m. The exciter will be belt connected. The plant is being installed in connection with a water-works pumping and filtration plant, the power house being located at the water supply which is about three-quarters of a mile south of the town. Steam will be supplied to the whole plant from two 72 in. x 16 ft. return tubular boilers mounted in battery, with the usual feed water heater and pumping equipment. An additional auxiliary motor-driven well pump in the town is to be operated electrically from this plant and controlled from the power house.

Contracts for this plant were let in August of the present year and the work is now under way, the power house being almost completed and all of the pole line being erected with the exception of the railway crossing. It is expected that the plant will be in operation by the end of January.

The Canadian General Electric Co. have the contract for the generator, switchboard and street lighting equipment. The Robb Engineering Co. are supplying and erecting the engine, boilers, steam piping and auxiliaries, also the steam heating system. The work is being carried out under the supervision of the John Galt Engineering Co., Ltd.

Yorkton, Sask.

The corporation of Yorkton, Sask., has just placed an order with the Siemens Company of Canada for another generator to be driven by a Diesel oil engine. The generator is of 400 kv.a. capacity, 3-phase, 60 cycle, 2200 volt, 200 r.p.m., with direct coupled exciter. This generator will be mounted on a solid bed-plate and be direct connected with a Mirrlees Diesel oil engine supplied through the Canadian Boving Company. It will be remembered that some eighteen months ago Yorkton installed a 80 kw. equipment of a similar nature which has evidently proven sufficiently satisfactory to justify them in their present purchase.

Prince Albert, Sask.

Recently the question of a street railway franchise was discussed by a representative of the Stone & Webster Corporation with the Prince Albert Board of Trade, but as the city authorities consider themselves committed by force of public opinion to the building of a street railway as a public utility, nothing was done. Prince Albert are developing at the present time, as a municipal enterprise, some 15,000 h.p. on the Saskatchewan River, which it is hoped to have completed next year some time. It is the present intention to link in the operation of a street railway with this water power development.

Telephone Progress

Since March 1st, 1912, eighty-four new companies have been formed in Saskatchewan with an aggregate pole mileage of 1366 miles with 1148 subscribers. The total for Saskatchewan now shows 336 rural telephone companies with 7516 pole miles. The total number of subscribers is 7980 which works out to a little over one subscriber per pole mile. The total capitalization is $1,006,0[illegible]5 or about $134 per pole mile and $127 per subscriber. In addition to rural telephone companies, there are twenty-one private independent companies not included in the above. There are also five companies operating under the Municipal Telephone Act which is now suspended.

Rapid progress has been made during the present year in long distance construction by the Saskatchewan government. Three new lines are being built towards the Manitoba boundary which have been completed as far as Marchwell, Fairlight and Welwyn respectively. The long distance line which is under construction along the main line of the C. N. R. westward towards the Alberta boundary has now reached Lloydminster. A similar line paralleling the C. P. R. has been completed as far as Gull Lake. The amount of construction completed since March 1, 1912, is approximately 800 pole miles and 1572 wire miles. This gives a total for the province to date of 2964 pole miles and 9741 wire miles. The number of toll offices opened and purchased to date is 228, and the total number of exchanges built and purchased to date is 80, with 12,802 subscribers.

Although it is the declared policy of the Bell Telephone Company to place gradually all their wires in the Montreal district underground, Mr. Jones, the manager, states that it is practically impossible to do so at the present time in the outlying districts. They therefore have applied to the city for permission to put up poles in places where the population is small. In some instances there are only two or three residents on a long street, and the company naturally do not feel justified in going to the expense of three or four thousand dollars in laying conduits. Wires have already been removed from 125 streets and placed in [illegible] or underground. The reply of the telephone committee of the city is a request that the city attorney apply to the Railway Commission to force the company to [illegible] wires underground.

The latest report of the Manitoba Government Telephone System which covered the first ten months of 1912 shows a total revenue of $1,212,461 as against an expenditure of $909,181 leaving a balance of $303,280. The number of exchange stations in operation on November 1st was 24,038, rural stations [illegible], private branch exchanges 3,108, extensions 2,926.

Electrical Development at the Pacific Coast

New B. C. E. R. Terminal

The B. C. Electric Railway Company has recently arranged with the city for the construction of a new Vancouver terminal for its Lulu Island interurban railway. This line extends from Vancouver through Point Grey to Eburne, from which point one division runs across Lulu Island to Steveston and another extends along the North Arm of the Fraser to New Westminster. Along this route settlement has been very rapid of recent years and a large commuter's traffic is carried on over the division. The line now enters Vancouver by a bridge spanning False Creek, terminating at a station at the water level. This location is inconvenient inasmuch as the station is located on low ground and passengers transferring to city lines must either walk up a steep hill or climb a special stairway to the level of the Granville street bridge, over which all the connecting city lines, except one, run.

The new arrangement proposed by the company is the location of an interurban terminal at the south end of Granville street bridge. By this plan interurban passenger cars will not be obliged to cross the False Creek bridge and they will be brought into the station directly on a level with the Vancouver city cars. The terminal will also be of advantage to the city system as it is located near 4th and Granville streets, an important city transfer point.

The depot will consist of two wings, each about 40 by 28 feet in size, connected by a covered passage way 25 feet in width, ample to accommodate the traffic from the interurban lines to the city system. In the south wing will be located the ticket office, agents office, etc., while in the opposite wing will be a general waiting room and separate ladies room. The terminal, being located on made ground, will be of wood construction. The plans call for a handsome structure which will cost between $30,000 and $40,000. The trackage arrangements provide a terminus for the Lulu Island cars on the west side of the station. The east frontage of the station is located directly on the Granville street bridge, all the Fairview cars of the company passing this point on their way to the business centre of the city.

Change in Route

The route of the Westminster interurban line of the B. C. Electric Railway Company, the original line connecting New Westminster with Vancouver and which started operation in 1891, was altered during the early part of this month through the completion of the Highland Park cut-off. The old line entered New Westminster along 12th street along which thoroughfare there was a very steep grade rendering extreme care necessary in the operation of heavy interurban passenger coaches or freight trains such as are used on this branch of the B. C. Electric system. The Highland Park cut-off leaves the old interurban line at Highland Park and proceeds by a winding route, taken for the sake of easier grades, into New Westminster. The running time between Vancouver and New Westminster has been lessened by ten minutes because of the change of route and the service is now operated on safer lines. With the Highland Park cut-off in service it will be possible for the company to carry out its plans of operating two car trains between New Westminster and Vancouver. This step is rendered necessary by reason of the rapid growth of the suburban traffic along the line both in the vicinity of Vancouver and New Westminster. The section of the Westminster interurban line which has been abandoned for interurban traffic will not be covered by cars connected with the New Westminster city system. During the month the B. C. Electric has also placed in operation an extension of its line, one-half mile in length, on Lonsdale avenue, North Vancouver. On Vancouver Island an extension of the company's system has also been opened operating along Hillside avenue.

No More Grade Crossings

The provincial authorities of British Columbia recently declared against the policy of the establishment of grade crossings, where these can possibly be avoided. Recently the municipal council of South Vancouver decided to establish a grade crossing at Rupert street, where the road crosses the Westminster interurban line of the B. C. Electric. A subway now exists at the point but it was claimed that this was too low for ordinary traffic. The management of the B. C. Electric entered a protest on the plans of the municipality and ratepayers holding property in the vicinity also entered objections. The question was argued before the Hon. Thomas Taylor, Minister of Railways for the province at Victoria. After hearing both sides, the Hon. Thomas Taylor stated that under no circumstances would he favor the establishment of a grade crossing at the point. The policy of all growing communities was to avoid grade crossings wherever possible and the idea of the South Vancouver authorities in substituting a level crossing for a subway at Rupert street would be a distinct retrograde movement. A few days after the argument the Minister of Railways announced his decision to the effect that the grade of the railway should be raised two feet at the road crossing, thus making possible a subway which would meet the conditions of the case.

For Motormen and Conductors

The management of the B. C. Electric Railway Company is providing for the comfort and convenience of the motormen and conductors employed on its Vancouver lines by the construction of a five storey club building at the corner of Main and Prior streets, Vancouver, this location being directly opposite the principal car barns of the company in the city. The building will have a frontage of 25 feet on Main street and a depth of 60 feet on Prior street. The Prior street frontage to the rear of the block is owned by the company and in the plans of the building arrangement is being made for the extension of the block should the need arise. On the first floor of the block will be located the general waiting room for the men and offices for the depot masters and inspectors. On the second floor will be a large billiard room which will be furnished with billiard and pool tables. On the third floor will be located the reading room and about one-half the floor space of this flat will be used for lockers. The fourth floor will be devoted entirely for lockers, this accommodation in connection with the third floor providing lockers for over 500 men. The gymnasium will be located on the fifth floor, the entire flat being left free of obstruction as far as possible. In this room will be installed a complete set of gymnasium apparatus. The upper floors of the building will be reached by an elevator as well as a winding stairway . Lavatory accommodations are provided on each floor. In preparing the plans, the company's architect has studied the plans of similar buildings operated by electric railways on the continent for their men and is arranging for a building adapted to local needs and conditions and up to date in every particular. The

block will be of brick construction, the frontage being trimmed with terra cotta. The estimated cost is between $30,000 and $40,000.

Will Raise Voltage

The B. C. Electric Railway Company is contemplating the alteration of its transmission system on the lower mainland of B. C. and the provision of an improved central service covering its large territory in that section. At present the company's transmission lines, carrying 40,000 volts, run from the generating station on the North Arm of Burrard Inlet to sub-stations at Burnaby and Vancouver, at which points the current is stepped down and distributed. The company's new plans as tentatively announced contemplate the erection of a large receiving station near Esmond avenue, Burnaby, along the route of the Burnaby interurban line. Current will be sent to this station from the North Arm power house at 60,000 volts and connections established from the central point with the various sub-stations, a loop system being formed so that alternate sources of power will be available at each point in case of accident to any part of the lines. The plant of the company, while not complete as to detail, are said to involve the reconstruction of the present pole lines from Lake Buntzen, equipping the line with 60 foot poles carrying metal cross arms and disc insulators of the suspended type.

B. C. Water Powers

Mr. G. Gray Donald, of the Provincial Water Branch, recently completed an estimate of the water powers on the Columbia, Pend d'Oreille, and Kootenay Rivers in B. C. Investigation shows that the amount of available water power in the districts visited will approximate ten times what had previously been supposed, and there is every reason to believe that the same proportion will apply in other sections of the province. The estimates made this year while not supposed to be absolutely accurate, are sufficiently near for all practical purposes. They are such that any one desiring to lease a water power will be able to ascertain by consulting the department records whether the powers available will be sufficient for contemplated purposes, together with all other necessary incidental data. Mr. Gray Donald states that a similar estimate is to be made of all the water powers in British Columbia.

Victoria, B. C. Street Lighting

The city of Victoria, B.C., is now consuming practically double the amount of power for street lighting purposes that was used a year ago. This is due largely to the steady increase in the street electrical illumination scheme by the extension of the cluster lighting system in the down town section, and of the arc lighting in the outlying districts. The total cost for the year will be in the neighborhood of $16,000. With the recent installation of new apparatus and machinery at the electric lighting station, the capacity of the arc lighting system has been greatly increased. So far this year about 160 lights have been installed, another 100 will be put in immediately, the re-arrangements of the circuit being completed.

Miscellaneous

The Pacific Great Eastern Development Company, a corporation controlled by the Pacific Coast Eastern Railway, Vancouver, has applied to the B. C. Government for a license to use from the Cheakamus River for power purposes 2,000 cubic feet of water per second. The Cheakamus River is a tributary of the Squamish River emptying into Howe Sound some 30 miles north of Vancouver. The water will be diverted at a point two miles below North Creek fork It is understood that the power will be used for lighting the streets and dwellings and for industrial purposes at Newport, which was recently acquired by the Pacific Great Eastern Co. from the Howe Sound & Northern Development Company.

The municipality of Esquimalt, Victoria, B.C., has awarded the contract for street lighting to the B. C. Electric Railway Company. The installation is a series tungsten system consisting of apparatus having a capacity of 275 80-watt lamps, of which 130 will be installed immediately and the balance from time to time as required. Current will also be supplied by the company. Messrs. Taylor & Gonnason, consulting engineers, Victoria, were called in by the Esquimalt municipality in an advisory capacity to report on the merits of the various tenders submitted.

Application is being made for extensive water rights on Brandt Creek, Indian River and Norton Lake by the New Westminster Power Company, Ltd., a concern backed by local and British capitalists. The plans of the company cover the erection of a 500 acre feet reservoir at Young Lake, one with a capacity of 10,000 acre feet at Norton Lake, a third on Indian River to hold 2,500 acre feet, and a fourth to control 10 cubic feet per second on Brandt Creek.

The Pacific Coast Eastern Development Co. is applying for a license to use 2,000 cubic feet of water per second from the Cheakamus river, a tributary of the Squamish in the Howe Sound district. The water is to be diverted at a point two miles below North Creek Forks. It is understood the power will be used electrically to furnish light and power at Newport.

The Nanaimo Electric Light, Power and Heating Co. will apply for a license to take 150 feet per second, in addition to their present record, out of Mill Stone river. The water will be used for generating electric light, power and heat in the city of Nanaimo and within a radius of fifteen miles.

The B.C.E.R. Company, Vancouver, have recently placed an order for 3 HB. Westinghouse control equipments. These are to be installed on three Dick-Kerr locomotives now being operated by this railway company.

The Vancouver Island Hydro-electric and Tramway Co., Ltd., has been incorporated with a capital of $500,000 with head office at Victoria, B.C. The usual licenses were applied for.

The Telkwa Light & Power Company, Ltd., has been incorporated with a capital of $500,000 to carry on the light and power business in all its branches with head office at Victoria, B.C.

The Cariboo Power Co. has been granted a certificate of incorporation. Head office Victoria.

The Westminster Power Co. has been incorporated with the usual powers. Head office Victoria

1264. Electrical goods.—An engineer at Manchester is open to act as buying agent for Canadian importers of electrical goods.

Montreal and the Province of Quebec

Transmission Line Design

At the last meeting of the electrical section of the Canadian Society of Civil Engineers, Mr. Julian C. Smith, chief engineer to the Shawinigan Water & Power Co., read a paper on "Transmission Line Design." This paper covered a wide range and dealt with many features in connection with the electrical and mechanical design of power lines. Several interesting and important points were brought out, among them being various methods of computing the electrical characteristics of the lines, and some indications as to the limits which exist in ordinary practice as regards voltage and regulation. In the discussion of the mechanical design, an argument was advanced showing how the most economical span could be determined, and various curves were shown on this subject.

Information of considerable value was presented by Mr. Smith in this paper, particularly dealing with the actual cost of the construction of transmission lines, and with figures as to the cost and distribution among the various components which go to make up the complete line. A discussion followed the paper and additional data was presented on the subject of testing steel towers by Mr. Kaelin, the assistant chief engineer of the Shawinigan Company; on formulae for determining sag in transmission lines by W. D. Bergman, tower line engineer; also operating data on the Shawinigan line by Mr. John Morse, operating superintendent. These three discussions formed a part of the main paper of the evening, and taken as a whole the paper, with discussions, was designed to illustrate the general subject, the design and operation of the new line from Shawinigan Falls to Montreal being considered typical.

Several points in the papers were dealt with by other speakers. Mr. K. B. Thornton, of the Canadian Light and Power Company, gave details of trouble on their transmission line, and pointed out that the public needed education on the dangers of interfering with the lines. He also remarked that more attention was now being given to transmission lines in building a plant. Mr. R. M. Wilson, of the Montreal Light, Heat & Power Company, spoke in favor of sectionalizing switches, as they enabled trouble to be so easily located and quickly repaired. He believed that with care lines of 30,000 voltages could be carried through streets. Mr. R. S. Kelsch stated that the paper was the most complete he had ever heard, covering as it did the entire subject of transmission lines. Mr. Kelsch expressed a preference for concrete over steel anchors. Mr. Gaspe de Beaubien also spoke, and Mr. Smith replied to the points raised.

Quebec's Water Powers

A report has been submitted to the Quebec Legislature by a commission appointed to make a study of the water powers of the province. Among the recommendations is the regulation of the flow of water in the St. Maurice River by the construction of a dam which would control the flow and give a much more even supply all the year round. The report states that records covering a period of twelve years at Shawinigan show that the flow fluctuates between six thousand and two hundred thousand cubic feet a second, according to the seasons. The regulation of the flow would therefore produce a considerable effect. The three dams existing on the Manouna tributary of the St. Maurice are not regarded as being sufficient. The project recommended by the commission is the damming of the St. Maurice itself at La Loutre (Otter) rapids. According to the calculations made, the damming would provide an even supply of 18,000 cubic feet per second throughout the year, at Grand'Mere, Shawinigan and La Tuquette. The cost of executing these works is estimated at $1,300,000, and the commission is of opinion that the expenditure would be justified. A series of figures showing what the increased revenue would amount to are given.

Municipalities Must Consent

The Bill of the National Hydro-Electric Company has been considerably modified by the Private Bills Committee of the Quebec Legislature. The company expect to be in a position to have 40,000 horse power by next September and 160,000 horse power in two and a half years' time. At the suggestion of the company's counsel, over one-half of the counties proposed to be exploited were dropped out of the bill; these are Montcalm, Joliette, Berthier, Richelieu, Vercheres, Laprairie, Napierville, St. Johns, Iberville, Missisquoi, Chambly, Chateauguay and Beauharnois. The counties remaining in the bill are Assomption, Terrebonne, Two Mountains, Jacques Cartier, Laval, Argenteuil, Soulanges, Labelle and Ottawa. The reason for this narrowing of operations is that the company are of opinion that they cannot do business over such a wide area as was at first proposed.

The big fight in committee was over the question of the approval of municipalities being obtained before the company can do business within their limits, and it was decided that this consent must be secured; in the event of a refusal, an appeal can be made to the Public Utilities Commission. This consent was strongly opposed by the company, on the ground that it would involve great delay.

Electric Reminiscences

Mr. W. D. Shaw of the Montreal Electric Co. gave some reminiscences of the early days in the Montreal electrical business at the weekly luncheon of the Electrical Association of the Province of Quebec, Montreal. He spoke of the time when the first telephone was installed in Montreal, and of Mr. F. H. Badger, Sr., selling the models and rights, received from Mr. Edison, for $100. This was without a transmitter. Mr. Shaw was employed at one time by Mr. P. W. Ness, who ran a wire to the Gazette office, from where a number of customers were supplied with power. The operations of the Royal Electric Company were referred to at length, including the company's participation in the street railway project. The names of many men who are now well known in the electrical world were mentioned as having been connected with this company, and it was also stated that the first electric light dynamo used in Canada was brought into Montreal. Mr. Fred Thomson, Mr. J. Bennett, Mr. Camp, and Mr. E. W. Sayer also spoke of incidents in the earlier days.

An important amendment has been made to the Bill of the Montreal Council, before the Quebec Legislature, asking for authority to contribute $2,000,000 towards the expense of the G. T. R. in removing level crossings and replacing them with elevated or underground tracks. It was decided by the Private Bills Committee of the Legislature that Montreal be allowed to contribute only on condition the tracks be sunk or placed underground and that the trains be operated by electricity.

Mr. Jas. Bennett Resigns

Mr James Bennett, superintendent of the electrical department of the Canadian Fire Underwriters' Association, Montreal, has resigned, having been appointed managing director of the Fire Prevention Company of Canada, Limited, which controls an electric automatic fire alarm system and fire preventive and protective appliance. Mr. Bennett, who is the first to occupy the position of electrical superintendent for the underwriters, at the outset encountered considerable opposition in his endeavors to improve electrical wiring conditions. By means of diplomacy, however, the objections of the contractors were gradually overcome, although even now the demands of the underwriters are sometimes considered to be excessive. The situation to-day, from the wiring point of view, has improved in a very marked degree, due to the work of Mr. Bennett and his staff of inspectors. He is the only Canadian member of the Electrical Commission of the National Fire Protection Association of the United States and Canada, and is also connected with electrical inspection associations in the United States. Mr. Bennett's resignation will become effective from the beginning of April.

Westmount Again Reduces Rates

The Electric Lighting Department of the city of Westmount, P.Q., had a very successful financial year, and it has been decided to again reduce the price of the current for private lighting. In 1909 the price was 10 cents per kilowatt hour, and by a series of gradual reductions it has been brought down to 6 cents, which is the rate for the new year, under five year contracts. Besides this, the price of street lighting, which in 1909 was \$73, will be \$55. In addition to a depreciation fund of nearly \$100,000, there is a sum of \$28,000 to the credit of profit and loss. Orders have been given for an addition of 50 magnetite arc lamps supplied by the General Electric Company, and it is proposed to erect a further 100 lamps in the spring. Following on the announcement of the reduction in price to 6 cents, the Montreal Light, Heat and Power Company, which also supplies Westmount with current, have decided to give their customers a similar reduction.

The "Journal"

The Montreal Electrical Society have issued the first number of their monthly "Journal." It is a very creditable production, well arranged and printed. Its publication is evidence that this society is very much alive, though it is less than a year since the society was formed. The contents of the "Journal" naturally deal with the doings of the members, outlining the history of the institution and showing the progress being made. Two meetings are held every month during the season—on the first Friday at the Y.M.C.A., Drummond street, when lectures are given, and on the third Thursday, at the Edinburgh Cafe, St. Catherine street west, when informal discussions on electrical subjects take place. The latter meetings are designed to be of a social character. At one of the meetings Mr. P. T. Davies, the president, gave a short lecture on "Resuscitation from electric shock."

Pumps for Ottawa

Heap and Partners, Limited, Montreal, are supplying the city of Ottawa with two Rees Roturbo centrifugal pumps in connection with the waterworks system. The pumps have a capacity of 3 million gallons each, and are to be electrically driven. The motors have been supplied by Bruce, Peebles & Company, Limited, Edinburgh, through Roper, Clarke & Co., Limited, Montreal, the eastern representatives. The two motors are of the 160 B.h.p. 2 phase, 60 cycle, 2100 v 1200 r.p.m., synchronous speed, wire wound induction type complete with drum type controller and resistance. The efficiency of the motors at full load is to be at least 9[illegible] per cent, and at half load 90 per cent; the power factor at full load is to be at least 90 per cent. The same firm are supplying the switchboard and auxiliary equipment.

St. Catharine Street Lighting

Provision has been made by the Electrical Service Commission, Montreal, for placing 3½ inch ducts for lighting purposes when the underground conduits on St. Catherine street are constructed. It is proposed to replace 57 arc lamps with 142 ornamental standards, and the Electrical Commission have made the necessary alterations in their plans so as to give the required service connections. The lamps will be placed alternately on either side of St. Catherine street throughout the distance that will be served by the new conduits, and they will be arranged in such a way that not only will there be a lamp standard at every street intersection, but one between the street corners as well. At the principal street corners there will be two lamp standards.

Twelve Units for "The Cedars"

The Cedars Rapids Manufacturing & Power Company have ordered twelve units of water-wheels aggregating 120,000 h.p. Nine units of 10,000 h.p. each will be built by the I. P. Morris Company, of Philadelphia, who will also supply the exciters, governors, pumps and auxiliary equipment. The remaining three 10,000 h.p. units will be built by the Wellman, Seaver & Morgan Company, of Cleveland, Ohio.

Miscellaneous

The bill of the Saraguay Electric and Water Company has passed the Private Bills Committee of the Quebec Legislature. A clause extending the powers of the company to allow the sale of gas was withdrawn owing to strong opposition. The company, by the bill, changes its name to the Montreal Public Service Corporation, which will also include the properties of the Canadian Light & Power Company, The Dominion Light, Heat & Power Company, and the St. Paul Electric Company.

The Laurentide Pulp & Paper Company have recently purchased a water power on the St. Maurice River capable of developing 25,000 h.p. With the addition of this new power, the company now has an available development of 70,000 h.p. Work has been started on the water power adjacent to the company's plant, and it is expected that the company will in the future go extensively into the power field.

In a Bill of the city of Quebec before the Provincial Legislature a provision has been inserted with the object of abolishing unnecessary telegraph, telephone and electric light poles. The city engineer will decide what poles are not needed, but his decision is subject to appeal to the Public Utilities Commission. Should the decision be against a company, the latter is liable to a fine of \$5 per day for each pole until the latter is removed.

Most of the large contractors and supply houses of Montreal have signed a petition to the city council asking that the Tramways Company be allowed to carry building material through the streets of the city. It is urged that this will reduce the cost of haulage, facilitate building operations, and lessen the cost of buildings.

The annual dinner of the Electrical Association of the Province of Quebec will be held on January 16, at Cooper's Restaurant, Montreal.

New Developments, Improved Designs, 1912

A Brief Review of the Trend During the Past Twelve Months in the Different Phases of Modern Electric Practice

Railway Development

There have been a number of developments in the railway field during the past twelve months that have contributed very greatly to the high state of perfection which electric railway engineering has reached. These developments indicate that more attention has been paid to the economic side of railway operation, such as improvements in car and locomotive equipments; generating and converting apparatus. Among these improvements may be mentioned the following:—

The use of high voltage direct current for traction systems; thus retaining the advantages of the d.c. series motor, which have been found so satisfactory on low voltage work. This system is frequently used where alternating current is available and it is not feasible to distribute high voltage in the towns served by the road. The high voltage direct current system can be installed as an addition to an existing 600 volt system, which is a decided advantage for interurban lines. A 1500 volt d.c. equipment can be used over the interurban section, and also over the 600 volt city tracks, on which latter the smaller cars can continue to operate. Supplying this high voltage direct current has called for a corresponding development in generating equipment, which has reached an unusually high degree of perfection. The current is furnished by either motor-generator sets or rotary converters, two direct current armatures being connected in series to deliver 1200 or 1500 volts.

The switching equipment follows the same lines as for the 600 volt equipment, with the addition of precautionary measures, such as heavier insulation, longer breaking distances, and removal of live parts from the operation. The breakers are mounted higher than the lower voltage type, and are generally operated by a rod similar to oil switches. The motors for this service have reached a high standard of development. The armatures are specially designed to withstand the higher voltage; having liberal creepage distances at each end of the commutator. The brush rings have extra heavy porcelain insulators, and the clearances from live parts are greater than in the 600 volt motor. The bearings are dust-proof, and the motor is entirely enclosed.

Electric locomotives continue to gain favor, and a number of roads already using them have increased their equipment, and several other roads have bought their initial equipments during the year.

Several cities have adopted radical departures in car construction, embodying some novel features, tending to reduce weight, and to facilitate rapid handling of passengers. These include the stepless car in New York, the "Near side" car in Philadelphia, the centre entrance car in Brooklyn, and the light weight car in Pittsburgh. Probably the most noticeable advance in railway motor design is the "light weight" motor for the Pittsburgh Railways Company, which was built by the Westinghouse Company for use on a car with 24-inch wheels. This design is the outcome of the tendency towards light-weight city cars, and the adoption of the 24-inch wheels by the Pittsburgh Railways Company. This is the lightest weight per seated passenger, double truck motor car ever built. The motor is humorously designated as the "Dachshund," since its long, drawn-out appearance reminds one of the canine of that breed. This attenuated feature is necessary in order to obtain space for material required for the desired capacity in the restricted space of 24 inches.

An increasing number of roads have adopted the use of the unit switch control, not only on multiple trains, but also on single cars.

One of the most important recent developments is the use of a new field control. This is effected by having a greater number of field turns on the motors, and by arranging the control so that a portion of the winding is cut out of the circuit. This results in saving in power consumption and flexibility of equipment, the same equipment being adaptable for use on city or interurban service. When a portion of the field winding is cut out, the characteristics of the motor are modified just as if the gear ratio had been instantaneously changed. When connected in this manner, the motor attains a higher speed than with the full field winding in use, and while the normal field is not so well adapted for starting the car, it is much better adapted for producing a high maximum car speed. In this way, a given equipment can be made to operate more nearly under ideal conditions, both in starting and free running, than if it must be arranged on some compromise basis.

Portable sub-stations are being more extensively used this year; a number of roads having adopted them. The uses to which they may be put are:—(a) as spare equipment; (b) to assist in locating the most advantageous point for a permanent station; (c) to assist at times of unusually heavy load.

Commutating poles as applied to rotary converters fulfil the same functions and result in the same advantages as when applied to generators and motors. This last year has seen a number of this type of rotary built, some of very large capacity, including one of 7500 kw., with a momentary capacity of 10,000 kw. A particular feature of this rotary is that it occupies but slightly more space than that of the 1500 kw. converters which it replaced.

Switchboards

One of the most interesting developments during the past year has been the economies in space effected by the use of 7-in. meters, permitting the manufacture of switchboards which have twenty-five per cent. less length than similar boards manufactured heretofore. This has been accomplished without any sacrifice in readability of meters. Boards equipped with the new 7-in. meters are, in general, of considerably neater appearance than those formerly equipped with the standard 9-inch meters.

Further development has been the application of black dials with white markings and white pointers to switchboard meters for use in locations which are poorly illuminated and which depend largely upon artificial illumination. Such black dial meters offer very little reflection and practically eliminate all glare from the face of switchboard, thereby considerably increasing the readability and ease of operation.

Desk control boards are being ordered in larger proportion than heretofore, as the advantages of this neat and compact method of control are beginning to be appreciated. Black marine finish for switchboards has practically become standard.

Oil circuit breakers and carbon circuit breakers have been re-designed and the use of laminated studs for circuit breakers and switchboard work has very greatly increased. They permit direct connection of these devices to the busbars, are in general much more desirable for heavy

capacity circuits, and form an unusually neat construction which is very pleasing in appearance.

Transformers

Increasing demand for power for all purposes is leading more and more to large generating stations. Water powers more distant from available markets have been developed, and, as longer distances are involved, higher transmission voltages than ever before have been and are being considered. Plants and transformers are now constructed for 150,000 volt transmissions. The efficiencies of transforming apparatus and the reduced cost of operation of large stations tends toward the concentration of generating apparatus in central points and the elimination of the isolated plant. In the tying together of towns by transmission lines, a network has resulted from which are served many communities which it had not hitherto been possible to serve. One of the most striking developments of the past year has been the installation of small capacity units along transmission lines. The outdoor transformer and switching equipment are contributing in a great measure to the development of small community or farm loads, which are readily appreciated by the transmission companies. There has been a large number of transformer installations by which one transmission company could supply power to another company in case of interruption to the service of either.

The development of the oil insulated, self-cooled transformer for very large sizes has also been a factor in the general development work of transmission. Transformers of the self-cooling type are now made in sizes as large as it is possible to transport by the railroads. The elimination of attendance, auxiliary piping, and the cost of water has made many an installation feasible which otherwise, on account of the cost of operation, would not have been commercially practicable.

One interesting development, or phase of the development, is the acknowledgment by foreign transmission companies of the superiority of transformers of American manufacture. An investigation of the export business shows that American made transformers are being used for most of the high voltage work in foreign countries. Transformers of American manufacture stand pre-eminently first in quality workmanship and satisfactory operation, and it is a source of great satisfaction to realize that this is being appreciated by foreign engineers.

Carbon Circuit Breakers

A new type of small and moderate capacity carbon circuit breaker has been developed, which is a modification of a type used some years ago. It is made mainly from punchings, is quite rugged in design, and is held in the closed position by the ordinary trigger arrangement. It is made for alternating current or direct current, one, two or three pole, up to 300 amperes and 600 volts.

The large capacity (2,000 to 14,000 amperes) carbon circuit breaker, placed on the market by the Westinghouse Company about two years ago, has been entirely re-designed during the past year to cover capacities of from 1,000 to 20,000 amperes. In the re-designing, the carbon arcing contacts have been coppercoated, providing a constant low resistance connection between the carbons and shunts. The secondary contact has been changed in design so as to provide a stationary contact at such an angle to the moving contact that there is not the same tendency to buckle the moving contact inclosing the breaker after the contact surfaces become roughened by arcing.

The a.c. forms of this breaker have been perfected with spacing between brushes so as to provide for better ventilation, and laminated studs have been provided so as to prevent heating on alternating current. All breakers have been given an exact a.c. rating, and are now listed with the various ratings applicable to direct current, and the different frequencies of alternating current.

Oil Circuit Breakers

The development during the previous year tended largely towards increase in capacities, and this has been carried still further during the past year, so that now practically all of the larger types of oil circuit breakers are of the modified design, and involve the following features:—brush contacts with butt type arcing tips; tanks are lap-welded and are larger, giving greater oil capacity and more air space above the oil. Above the tanks in some of the larger types is a cast bronze gas expansion chamber, with a baffled vent for the escape of gases. The tanks are supported, in addition to the ordinary clamps, by steel rods from the cast base to a steel plate under the tanks, thus preventing any possibility of the tanks being blown off by an extra violent short circuit. The mechanism of the breakers has been improved so as to provide quick action, with dash pots to take care of both opening and closing shocks. With these improvements the instantaneous direct connected breaking capacity has been greatly increased in the different types.

A new breaker of the same characteristics as one of the well-known masonry types (E) has been brought out for mounting on the wall or pipe framework. It requires no cell structure, and because of this omission has a larger breaking capacity than the corresponding size for masonry-mounted breakers.

The type GA (44,000-110,000 v.) breaker, having a separate tank for each pole, previously limited to 300 amperes capacity, has been increased to 600 amperes; and a modification of this type has been developed for use on from 11,000 to 44,000 volt circuits, and possessing a lower breaking capacity. They have porcelain bushings instead of the condenser terminals, and are supplied for outdoor mounting.

A newly developed line of circuit breakers, known as the "Reactance" type, has been supplied in some forms, and designs are available for application of the reactance principle to other breakers. With the double break and a reactance inserted in the second or final break, the ultimate breaking capacity is unlimited.

Industrial Motors

Considerable development has taken place in the application of a.c. slip-ring, phase-wound induction motors for the operation of large electric shovels. Sixty-ton shovels so equipped are now in operation in the Northwest, and one equipped with 25-cycle motors is now under construction for use in an ore mine in Sweden. In connection with machine tool application, the most prominent advances have been made in the reversing planer motor and controller. Another interesting development is the application of electric motors to logging donkeys. The development of self-starting synchronous motor for direct connection to air compressors, while not really a new development in 1912, has now been perfected and is practicable for all commercial purposes. A greater number of these outfits were installed in 1912 than in all previous years.

Commutating Pole, Direct Current Motor

There has been practically a universal endorsement of the commutating pole, d.c. motor, including various classes of industries. Much improvement in the mechanical features, such as frame, bearings and shaft, insulation, type of winding, etc., has been devised, but it is only recently that the commutating pole feature of motor design has reached such

a state of perfection, this being due to a fuller understanding of the principles involved.

At the present time, the commutating pole feature is incorporated in motors for machine tool drives and similar applications, and for the more severe classes of intermittent service, such as street railway and steel mill applications, where the work is of widely varying and often reversing nature. In machine shop work, the commutating pole motor is capable of a wide range of speed variation, with heavy overloads, and the intermittently rated motor gives greatly improved commutation through a wide range of load conditions which, as a rule, includes peak load during acceleration, and even higher loads during reversing for such as cranes and general mill service.

The principal advantages afforded by the use of the commutating poles are,—increased reliability, increased life of apparatus, reduced repairs. The improvements mean,—greater continuity of service, less supervision of apparatus, and, in many cases, provision for increased working capacity of machinery. The net result is increased plant efficiency, and there are incidental advantages which will become more definitely established as the user's experience with this design of motor is increased.

Electrically Operated Steel Mills

The have been a large number of new steel mills built during the last several months, and in almost every case electric drive has been considered for the main rolls. In many cases, it has been adopted in preference to steam engine drive. Many of the larger steel companies have existing electric power plants which deliver energy at a cheaper rate than steam can be supplied for an isolated mill engine, the advantages being obtained by the use of gas engines or turbine drive. In the latter case, the plants may include low pressure steam turbines, using exhaust steam from existing mill or power engines or may include turbines using steam from the blast furnace plant where steam can be generated very economically by burning blast furnace gas under the boilers.

The reliability and many mutual advantages of motor drive for steel mills are well established, and it has received the endorsement of many prominent steel mill engineers. The first and practically only question regarding the majority of the applications is "cheap electric power," and as the central stations are doing much to solve this question, it is safe to predict that motor drive will become more universally adopted in steel mills, even for the more severe classes of service, such as reversing mills, etc.

Mining

In the mining field probably the most important advancement as regards the use of electricity has been the remarkable increase in the activity of central stations in supplying of power to coal mines. Not only have existing central stations contracted for vast amounts of power for this purpose, but large companies have been developed almost exclusively for supplying power to coal mining operations. Out of this has grown another development in the application of heavy shaft hoisting in coal mines, as heavy electrical hoists have heretofore been almost exclusively in metal mines, where fuel has been comparatively high in cost. With the central station power, however, the situation is very different in that the mining company does not have to stand the investment of the necessary power house equipment for electric hoists, which in an isolated plant makes the use of heavy electric hoisting almost prohibitive on account of the interest and investment feature and the comparatively small amount of energy consumed in power, giving very poor load factor. Another important development is a greater use of electrically driven air compressors in metal mines, of which a large number have been installed with direct coupled slow speed motors.

In the construction of mine locomotives, the cast bar steel frame bars, during the past year, become very popular, and operators are insisting upon this construction in the heavier locomotives, where the advantages have not been claimed to be so important on account of the greater proportion of weight in the frame itself, which ordinarily gives sufficient strength in cast iron. Notwithstanding the large number of these locomotives installed, there has been no report of failure of these frames in operation. The commutating pole motor has likewise become exceedingly popular, as this feature is particularly beneficial in this service, where the electrical equipment suffers extremely heavy overloads at times, and where the care and inspection given to the equipment are a minimum.

Motor Operated Coal Docks

During the past year several coal dock equipments have been installed, and though steam-operated rigs were estimated on originally, the majority of the plants will be motor operated throughout. Power will be furnished by central stations. As compared with steam drive, the first cost of the dock equipment is less (all power charges being omitted). The operating costs are much less, and the additional load is a decided advantage to the central stations, to the mutual advantage of both. As the amount of power and load factor increases, the cost of power is reduced and a more advantageous rate can be established for the entire community.

Motor Operated Open Hearth Furnace Doors

Motor drive is superseding hydraulic drive in many steel mill applications on account of absence of freezing and other troubles. A practice which is rapidly becoming quite general is the use of motors for lifting the doors of the open hearth furnaces. The mechanical features are simple, and a practical design is to make a separate and complete unit, including motor, control, gearing, etc., for each door.

Watthour Meters

The lower priced, low capacity house-type watthour meter has been extended to capacities up to 25 amperes, and a standardized form of bottom-connected meter has been produced and regularly listed. The gear train has been changed so as to include double reduction in the sub-gear train between main disk shaft and the worm, instead of using single reduction with one large gear wheel. The sub-gear train bearings have been lubricated. A new type d.c. watthour meter has been produced which differs from the previous standard meter in having the armature in the centre, the gear train at the top, and the damping disk at the bottom of the shaft. The meter is similar to others on the market, but differs from them in having spring-supported ball bearings.

Portable Meters

A new induction type ammeter has been placed on the market, which supersedes the older type, having a damping disk running between permanent magnets. The meter is by this means highly damped, and by means of other changes the total weight of the moving element is not increased. The winding has been changed, giving as a result a highly damped, extremely high torque meter, with minimum weight of moving element.

A D'Arsonval type meter has also been brought out to

supersede an older type. It has single air gap connection with permanent magnets rigidly mounted before they are magnetized and aged. The magnets need not be disturbed in removing moving element for inspection. Special attention has been paid to ease of inspection and repairs. All parts are mounted on a die casting, which can be easily removed from the box, allowing inspection of all details with minimum amount of handling.

Another type meter has been developed that operates on the dynamometer principle, and will be supplied as voltmeters, wattmeters and power-factor meters. This line of meters will present new features in the following points:—higher torque, and lower weight of moving element than previously obtainable. Special attention has been given to the mounting of parts for greater permanence of calibration and ease of inspection and repairs.

Indicating Meters

The induction type switchboard meters have had the weight of the moving elements decreased by the use of aluminium shafts with steel pivots. Name-plates with white background and black letters have been adopted as standard, thus showing entire length of pointer against a white background. Meters having black dials with white pointers and white figures have been developed and applied on several switchboards.

The automobile type meter has been developed and placed on the market. This is a meter three inches in diameter; made on the double air gap D'Arsonval principle. It is supplied in three forms: ordinary round type for use on either automobile dashboards or on small switchboard panels; flush type mounting for automobile dashboards, and illuminated dial type for automobile dashboards. For illuminated dial type, the illumination is indirect entirely; thus preventing any glare in the eyes. Workmanship and accuracy are of the same high standard as switchboard meters.

A new low-priced graphic meter has been developed. It has a moving iron element similar to the Bristol round chart meter. It is supplied as a voltmeter, and as a 2 or 3-wire ammeter, and for either a.c. or d.c. service. This meter represents a direct advance over the round chart meter in that it has a continuous paper scale long enough for seven days' record at one inch per hour. It has a seven-day clock, and a new type of pen which will carry ink enough for seven days. The meter as shipped is available for either portable or switchboard service.

Turbo, Waterwheel and Engine Generators

Modern practice in power plant construction is constantly advocating changes which lead to lower first cost, higher economies, and greater simplicity of operation. One method of attainment lies in the use of larger capacities in single units. During the past year a number of contracts for hydro-electric stations have been placed, which call for 12,000 to 17,500 kv.a., and even larger generators are in prospect. These are either of the horizontal or vertical types, and a wide range of speed is covered. Improvements due to a wide experience, have been made in mechanical construction, ventilation details and armature construction. A relatively cheaper, more efficient, and more reliable unit has resulted.

In steam practice a similar progress is being made. There have been designed and are building horizontal units of 15,000 and 20,000 kw. for speeds of 1800 and 1500 r.p.m., and even larger high speed units are contemplated. Single turbine generators of 30,000 kw. capacity for a speed of 1500 or 1200 r.p.m. for 25 and 60 cycle service, is a possibility of the near future. Modifications of design have been effected whereby the materials used are not stressed materially harder than in smaller units, which have already demonstrated the success of their designs, and different companies are prepared to offer the high capacity, high speed outfits upon demand. These units are also being wound for voltages as high as 13,200.

(Concluded in Jan. 15 issue.)

Decision in Suspension Insulator Case

This is an appeal by Steinberger, President Electrose Manufacturing Company, from a decision of the Examiners-in-Chief affirming the decision of the Examiner of Interferences awarding priority of invention to Hewlett as to the following issue:

1. A disk strain insulator, comprising suspension members, a mass of insulating material partially enveloping the same, said mass being provided centrally with a disk integral therewith and lying substantially in the general equatorial plane of said mass, and further provided with flanges extending in opposite directions from said equatorial plane.

2. A disk strain insulator, comprising suspension members, a mass of insulating material partially enveloping the same and having a disk portion, said disk portion being provided with annular collars extending in opposite directions and in the general direction of said suspension members.

3. A disk strain insulator, comprising strain members, a body of insulating material partially enveloping the same and having a comparatively large disk, said disk being provided with collars integral therewith and extending in opposite directions.

The invention relates to disk strain-insulators for electric conductors designed to mechanically secure and at the same time electrically insulate two connecting parts. It was desired to construct these insulators so as to prevent creepage of current over the surface thereof, not only in dry weather, but in wet weather as well, and this was accomplished by the construction claimed.

In dry weather the irregularities in the surface of the sides of the disk provide against surface leakage by making additional surface without increasing the diameter of the disk, while in rainy weather the same irregularities collect and dispose of the water and prevent the formation of a film of water on the sides thereof, which film if present would cause a more or less perfect electrical connection between the parts intended to be insulated from each other.

It was shown that Steinberger disclosed his invention by letter to a customer as early as October, 1905, though his patent was not filed until January 20, 1908. The evidence also showed that Hewlett filed his application on April 20, 1907, having obtained the secret of the invention from the afore-mentioned letter. It is held that Steinberger is the original inventor of the issue and the decision of the Examiners-in-Chief is reversed.

Many Happy Returns

We congratulate our contemporary, The Electrical Review, on having just celebrated its fortieth birthday. Forty years ago the field of electricity did not promise a very rich harvest, and the founders of this magazine must have possessed more than the average intuition in foreseeing so many years in advance what the rest of us required another thirty years to recognize. We are pleased to note that the policy of The Electrical Review through all these years has been one of steady development and increased usefulness, and we hope that it may long continue to occupy the high position it has attained among electrical magazines.

The income of the Montreal Light, Heat & Power Company for the six months ending October 31, 1912, showed an increase in net of $171,000.

ELECTRIC RAILWAYS

Saskatoon's new street railway equipment—Length over all 34 feet 4 inches.

Saskatoon's Municipal Railway

The accompanying photographs illustrate the new cars recently furnished by the St. Louis Car Company to the city of Saskatoon, for their new railway system. The cars are single truck, double end, straight sided, with drop platform, arched roof, clam shell detachable hood, double sash (top sash stationary, lower arranged to raise) length over body corner posts 21 ft. 4 in., length over all 34 ft. 4 in., length of platforms 6 ft. Bodies are mounted on St. Louis Car Company's No. 72 truck, and are equipped with Consolidated Car Company's buzzer system, International Register Company's type R-5 register, Consolidated Car Company's electric heaters, St. Louis Car Company's ventilators, St. Louis Car Company's foot gong, Hunter destination signs, St. Louis Car Company's sand boxes, H. & B. life guards, Kalamazoo Railway Supply Company's track scrapers, U. S. head-lights, Pantasote curtains, Agasote ceilings, Wilson trolley catchers, twelve cross and four longitudinal rattan seats. The cars were equipped complete with electrical equipment at the St. Louis shops, and shipped ready to enter service.

Saskatoon's new railway equipment.

Contract for 65 Cars

On November 26th the management of the B. C. Electric Railway Co. announced that a contract had been closed with the Preston Car and Coach Co. of Preston, Ontario, for 65 city passenger cars. This is the initial order of the company for 1913 delivery. The cars are to be of single end type and 44 feet in length. The specifications are still subject to minor changes but the cars will be of the latest model throughout. Delivery will be made during the months of April and May.

The company expects to operate its interurban line from Victoria north through the Saanich Peninsula, 22 miles in length, about the first of the year. For this line orders for rolling stock have been placed as follows: 2 baggage and express cars from the Niles Car Company and 6 passenger cars from the St. Louis Car Company. For freight service 15 flats and 25 box cars have been ordered from the Seattle Car Company and two 45 ton locomotives will be taken from the mainland system of the B. C. Electric for use on the new interurban line.

For service on its mainland freight lines the B. C. Electric has recently ordered 25 box cars from the Seattle Car Company and five 50 ton locomotives from the Westinghouse Company of Pittsburg. Other rolling stock recently ordered by the company consists of 2 snow sweepers from the Ottawa Car Company and 6 Hark-Otis steel dump cars.

During the month full delivery has been made of the 24 interurban cars ordered by the company from the St. Louis Car Company last summer and this equipment is now in service. The initial shipments have also been made by the Brill company from its Philadelphia shops on the large order for city passenger cars recently placed with that concern.

In announcing its contract with the Preston Car Company, the management of the B. C. Electric stated that it was not the intention of the company to abandon the car building work in connection with its New Westminster shops. It was stated that the schedule for new rolling stock for all lines of the system for 1913 is now being prepared and in this programme ample work would be allotted to the New Westminster plant. At these shops are now being

assembled and finished a shipment of 25 steel city passenger cars which have been constantly arriving on an order placed some time ago in the old country.

Morrisburg and Ottawa Electric Railway

Construction on a new electric railway to run from Ottawa to Morrisburg and several other towns and villages in the Ottawa Valley is to commence next March according to statements made by directors of the Morrisburg and Ottawa Electric Railway Company, of which J. G. Kilt, of Ottawa is president. The company is capitalized at $500,000, $150,000 of which has been subscribed and $30,000 paid up, the balance being subject to ten per cent calls. The main line of the railway is to be from Ottawa to Morrisburg via Ridgmont, South Gloucester, Metcalfe, Norwood, Chesterville, Winchester, Williamsburg to Morrisburg, and will be forty-seven miles long. Subsidiary lines will total in length 50 miles and will run to Russell, Manotick and points in the Rideau Lake district.

The route for the main line has been surveyed and the report of the engineers will be submitted to the directors some time this month. Tenders for poles, ties, rails and general equipment for such a road are to be invited almost immediately. As a matter of fact some tenders have already been sent in. Whether electric power will be used or whether gasoline-electric cars will be used is a matter yet to be definitely decided. It is hoped to have part of the road in operation by next August. How many cars and how much material for equipment will be needed is not definitely known at present.

The company have been given permission by the Board of Control to have a by-law submitted to the people in January asking permission to enter the city by some route yet to be determined. The officers of the company are: J. G. Kilt, Ottawa, president; Hector Macdonald, Ottawa, vice-president; James Oliver, Ottawa; R. E. Reardon, Ottawa; R. J. Biggars, Ottawa; J. W. Bogart, Norwood; William C. Strader, Williamsburg; R. A. Bishop, secretary-treasurer. The offices of the company are in the Canada Life Building, Sparks street.

Ottawa Car Company Extensions

The Ottawa Car Company, Limited, are adding a new and up-to date machine shop to their present plant at Ottawa. This building is 66 ft. by 135 ft., four storeys and basement, and is of solid brick and fireproof construction. The company are now running to their full capacity. They have recently received some very large orders from western cities, including Calgary, for which city they are building twelve p.a.y.e. cars, 46 ft. over all, with Brill 27 G.I. trucks, mounted with steel wheels and equipped with Westinghouse 101 B. motors and air-brakes. The order also includes six trailer cars, 44 ft. over all, centre entrance, p.a.y.e. type, and one standard single-truck double-broom snow sweeper. Calgary has already in operation a number of cars built by the Ottawa Car Company, which are giving excellent satisfaction. This company has also on order for Moose Jaw, six, 21 ft. body, single truck, and two, 33 ft. body, double-truck p.a.y.e. cars.

Ask Extension of Time

Notice has been given by the Niagara, St. Catharines and Toronto Railway Co. that they will apply to the Parliament of Canada at its next session for an act extending the time within which the company may construct the following lines: (1) Port Colborne to Fort Erie to the City of Niagara Falls, (2) from the City of Niagara Falls to the town of Niagara to St. Catharines, (3) from the town of Welland to the city of Brantford, (4) an extension of the St. Catharines and Niagara Central Railway Co. to a point on the Niagara River near Fort Erie and an extension to the city of Toronto by way of Hamilton or thereabouts.

Commissioner Upholds W. E. R. Co

An application was recently made to the Public Utility Commission of Manitoba on behalf of the city of Winnipeg for an order requiring the Winnipeg Electric Railway Co to operate street railway cars on the bridge at Arlington street over the C. P. R. tracks. The application was resisted by the street railway company. The objection was raised by the street railway company that the approaches are so steep as to render street railway traffic dangerous to a degree that would jeopardize the lives of the passengers.

Commissioner Robson based his decision on the reports of two engineers—John Woodman, C.E. of Winnipeg, and R. M. Feustel, C.E. of Madison, and on his personal knowledge of the situation and in the interests of public safety declined to assume the responsibility for granting the order.

London Street Railway Extensions

The London Street Railway Co. are installing an Allis cross-compound, 20 in. x 38 in. x 48 in. Corliss engine and 500 kw. generator and are building an extension to their engine room sufficiently large to accommodate this additional unit. The extra power unit is made necessary by extensions to the road and additions to rolling stock of the London Street Railway Company's system.

Miscellaneous

The Allis-Chalmers Co. of Cleveland, Ohio, have recently closed a contract with the Sandwich, Windsor and Amherstburg Railway Co. for a horizontal, cross-compound, Corliss engine with cylinders 32 and 52 x 42 inch stroke. Operation will be at 100 r.p.m. and the engine will be direct connected to a continuous current generator of 850 kw. capacity for carrying the railway load.

The Niagara, St. Catharines and Toronto Railway Co. have commenced grading work on the St. Catharines to Niagara-on-the-Lake extension. This is a distance of twelve miles. The entire work including the grading, trestles, track laying, etc., is being carried out by the company's own men under Mr. E. F. Seixas, general manager.

A scheme is on foot to connect up the cities of Regina and Moose Jaw by an interurban electric line. A syndicate supposed to have the matter in charge has been represented in Regina by a Mr. Friedman of Seattle who had conferences with the Board of Trade and the city council.

The net profit of the Guelph Radial Railway Co. for the year ending September 30, 1912, amounted to $7,839. After paying a dividend of 4 per cent., sufficient surplus remained to purchase a new electric sweeper for snow cleaning. The assets of the company now amount to $172,418.

Petitions have been circulated and largely signed by North Rosedale and Moore Park residents, asking the Toronto Street Railway Co. to extend its Church street line across Glen bridge, up Glen Road, thence west and south to the bridge again, completing the loop.

Illumination

Artistic and Efficient Fixtures

There is probably no branch of the electrical industry where more noticeable advance has been made in the past few years than in the development of artistic and efficient electric fixtures. These are now so varied in design that it is difficult to give any adequate idea of the beauty of some of these products. Of course, as in other lines, there are different types for different purposes, also hundreds of designs for each of the different types.

Fig. 1

The indirect and semi-indirect illumination are very popular to-day, but the old standard of direct illumination will never be done away with, and the probable changes in this style of illumination will be towards more elaborate and more efficient fixtures. One of the most novel features for the direct-type of illumination that has ever been designed has been placed on the market recently by the Tungstolier Company under the trade name of the T. T. C. Tungstolier. This particular fixture is different, absolutely, from anything that has ever been placed on the market. It has many features which are not only interesting to the electrical trade, but also just as interesting to the builder or consumer.

One will find many stores and offices that to-day may consider their illumination quite satisfactory and perhaps in a year's time they feel that they would like to increase their illumination, but are not in favor of going to the expense of entirely new fixtures. This is one of the features that can be overcome with the use of the T. T. C. Tungstolier.

Fig. 2

In Fig. 1 which shows the trunk, it will be noted that around the circumference of the trunk there are a number of buttons which can be unscrewed. In behind each one is the "live contact" ready to receive any of the arms that are shown below. That is, by removing these buttons in the proper place one can make a two, three, four or six light fixture. From this one can readily see that a builder would be in a position to equip all the offices with, for instance, three light fixtures. In the event that some merchant would rent one of these offices and would require more light than usually needed, new fixtures would not be

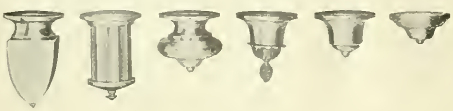


Fig. 3

necessary. It would simply mean the purchase of one or two arms and the necessary increase in illumination is obtained.

Fig. 2 shows an assortment of canopies. These cover a round, a square, and a handsome cast canopy. This article is made for both the close ceiling and the stem type T. T. C. Tungstolier. Besides this there are six bottom shells shown in Fig. 3, which can be attached to any of the trunks by merely inserting three screws. There is no iron pipe to thread or to worry about. After you have proceeded and selected the canopy and the bottom shell the next proposition that confronts you is the arms. In the T. T. C. Tungstolier product there are 18 types of arms.

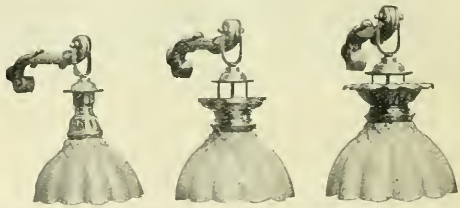


Fig. 4

As a matter of fact six distinct types and an assortment of three to each type, which consists of an arm without any decoration over the socket, another arm with a very substantial spinning, and another assortment with a heavy massive casting. This arm is put in place into the opening in the circumference by merely shoving same in and locking, and an immediate connection is made. There is absolutely no splicing or soldering of wires.

Referring now to the importance of scientific lighting;—several articles have appeared in the Electrical News from

Fig. 5

time to time, on the use of the proper lamp and a proper glass and shade holder. As a rule the original installation is properly laid out for the initial equipment, but where the mistake lies is in changes after the first installation. For instance if a fixture is designed for use with 40 watt lamps, and at a later date the consumer would use 60 watts, the reflectors would be inadequate as well as the shade holders, and as a rule it is a mean job to change a shade holder. This has all been overcome in the manu-

facture of the T. T. C. arm. By simply a slip up or down the T. T. C. arm is changed to the proper location for either a short base or a long base lamp. It is a splendid feature and a great labor saver. These fixtures have met with great success in the United States. Central stations who have been renting simple fixtures with no elaborations in the past, are now adopting the T. T. C. Tungstoliers for

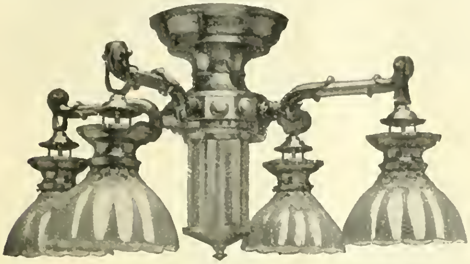


Fig 6

the reason that with a small assortment of trunks and an assortment of arms they have, at their command, any number of fixtures in two, three, four or six lights. In fact, practically any requirement from a massive cast fixture to a neat simple fixture can be obtained with the use of the T. T. C. Tungstoliers. One of the main points in the T. T. C. line is the method by which a dealer can minimize his stock and still have a large assortment of fixtures. For an investment of about $185 very nearly 1944 designs can be made. This is made possible simply by the interchange of the canopies, bottom shells, arms, etc.

Show-Case Lighting

It is a matter of surprise to the illuminating engineer the way the average central station man will jump at the opportunity afforded for lighting a few feet of show windows when the showcases in most stores, presenting an area about ten times greater, are allowed to go unlighted and neglected. In a recently completed modern department store of the east there were only 250 feet of show windows to light, while the interior of the store contained an aggregate of nearly 4,000 lineal feet of cases—an opportunity for the sale of almost sixteen times as much current. While it is true the average store does not have 4,000 feet of show cases, it does have a sufficiently large number to make a very inviting proposition.

Probably the current man would hesitate to believe at first reading that only from twenty-five to forty per cent. of the stores of his country use any show case lighting at all. And more, a large proportion of this percentage is most inadequately lighted, so that additional current could be judiciously used in connection with a properly designed reflector system with a noteworthy increase in display efficiency. Ordinarily, four 25-watt lamps will suffice to satisfactorily light each eight lineal feet of case, but a very good

Fig. 1—Type A reflector.

rule to follow for the proper show case standard of illumination is approximately double the exterior general illumination. Experience has shown that an intelligent consideration of these two figures will enable any central station solicitor to make recommendations that can be safely relied upon to secure desired results, and assure in many instances much new business in a field which has as yet been only "scratched" on the surface.

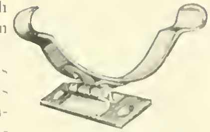
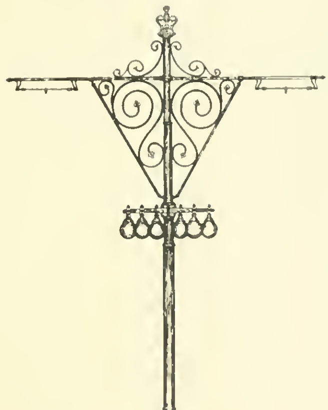


Fig. 2 Hinged clip

One of the most recent methods introduced for lighting show cases is the J-M Linolite system of illumination made by the H. W. Johns-Manville Company, New York, which consists of a tubular electric light nearly a foot long with the filament stretched out straight. These lamps, complete with reflectors, only occupy a space of 1½ inches deep by 2½ inches wide, and can be easily attached to or detached from the case by means of spring clips. These clips are readily adjusted to the interior of the show case, and firmly support the removable shell in its proper position. An ornamental or plain stand pipe or wire conduit is then run down in a corner and through at one end of the case into an outlet box under the base of the case. A single pole flush switch is usually provided for this outlet box so that the lights of each case may be individually controlled when desired.

Plaza Lighting in Ottawa

The Ottawa Electric Railway Co. are to be commended for the care they have taken in installing ornamental posts to harmonize with the general scheme of beauty on the Plaza, the new wide thoroughfare just completed by the Dominion Government in front of the Chateau Laurier. The accompanying illustration indicates the general design of the standard. There are four of these across the Plaza erected



on the six foot way between the tracks. The standards are 23 ft. 6 in. from the ground, and the cross arms which support the trolley wires are 14 ft. long and 20 ft. above the tracks. The crown is an Imperial design colored in blue and gold. The posts were designed and erected by the Ottawa Car Company and have come in for much admiration from the citizens of Ottawa and from Canadian legislators at present in session there.

Application is being made by the Moose Jaw Electric Railway Co. for power to extend its lines outside the city of Moose Jaw and to increase its capital from one-half a million dollars to $1,000,000.

Correct "Semi"-Indirect Illumination

Owing to the success of the Indirect lighting appliances that were placed on the market only a few short years ago, many different types of other Indirect, and so-called "Semi"-Indirect types have since then been brought forward. Of these the "Semi"-Indirect lighting fixtures, which are really nothing but modified direct lighting, have perhaps met with most favor. The science of illumination is of such recent development that comparatively few understand its basic principles. While the people at large demand more rational illumination than formerly, the introduction of correct practice has been a campaign of education,—education not only of the masses, but an education of thousands whose business is that of lighting equipment, or lighting in its numerous branches.

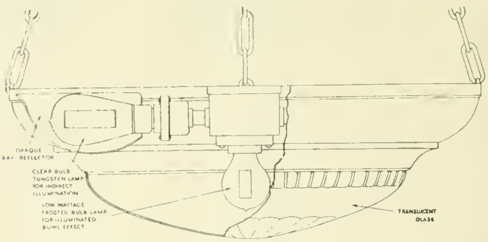
Years of experience in tens of thousands of installations, numerous exhaustive tests by those in the business as well as by many of the largest companies in this country who have adopted Indirect illumination, have proven that the following essentials are necessary for economic and complete success in Indirect lighting:

The most powerful of reflective surfaces.
Scientific design of the reflector.
Permanent efficiency of the reflector.
Low maintenance cost (ease in cleaning).
Correct engineering practice.
Correct ocular practice for greatest eye efficiency.
Variety and harmony in fixture design.

While some of the various types of "Semi"-Indirect lighting fixtures are attractive from a decorative point of view, experience is proving the contention that fixtures of this character, with brilliantly illuminated bowls, are not correct in practice for economical and seeing results. This is proven by the users of same in most instances coming back and installing in combination with them the old objectionable desk lighting. The reasons for this are:

(a) Owing to the absence of control of the light rays, there is a considerable loss of light by absorption on that portion of the interior of the room a considerable distance both ways from the ceiling angle.

(b) There is a loss by the absorption of light by the translucent bowl.



(c) There is difficulty in cleaning most of the translucent bowls and in restoring them to their original translucency after the dirt becomes ground in by a few cleanings.

(d) The intrinsic brilliancy of the direct lighting source is not reduced sufficiently to enable the eye to work to full capacity.

Now that the knowledge of correct practice in illumination is becoming more widespread, it is calculated that in cases where the consumer desires "to know where the light comes from," or where a translucent effect is desired, there should not be over 6 per cent. to 10 per cent. of the total light generated diffused through the bowl. Engineers now contend that in no instance should this luminosity be of greater intensity than the ceiling.

This translucent bowl effect is very easy to secure by using a small lamp in combination with efficient Indirect lighting equipment, installed underneath the interior equipment in the bowl, to give approximately the luminosity mentioned to that part of the body of the fixture made of translucent material. This has been worked out very satisfactorily in Boston, Toronto, Chicago, St. Louis, and many other cities. The accompanying illustration shows how this is done. Such lighting fixtures lend themselves to a great variety of designs to harmonize with the different classes of interiors.

Winnipeg Street Lighting

Fig. 1 shows the type of street illumination being now largely adopted by Winnipeg. These standards are spaced


Fig. 1

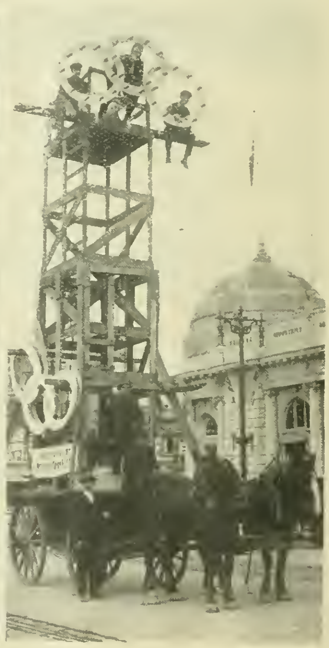


Fig. 2

about 80 feet apart and are equipped with two 6.6 ampere magnetite arc lamps. Fig. 2 shows the method adopted for erecting festoons on the occasion of a recent celebration.

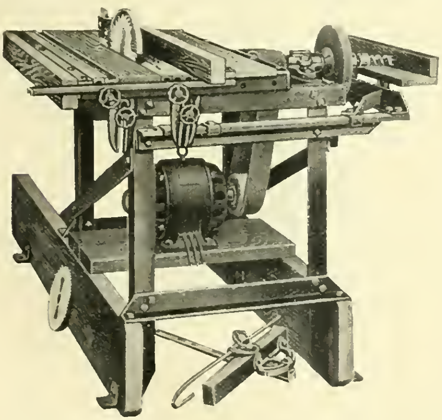
Consulting Gas Engineers

Messrs. Woodmansee, Davidson & Sessions announce that they have associated with them in the capacity of combustion engineer, Mr. C. M. Garland, late of R. D. Wood Company, and formerly of the Faculty of the University of Illinois. Mr. Garland has had extensive experience in theoretical and practical combustion work during the past ten years, and has specialized in the gasification of fuels and the application of producer and water gas to industrial and power requirements. After January 1, 1912, this firm, in addition to their present line of work, will be open for consultation on the design and operation of producer and water gas apparatus, gas power installations, gasification of low grade fuels, and the application of gas to the various heating problems.

The Dealer and Contractor

Motor Driven Circular Saw

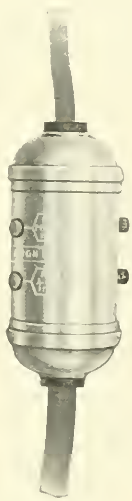
The accompanying illustration shows a remarkably serviceable combination woodworking machine made by the Parks Ball Bearing Machine Company of Cincinnati, Ohio. This machine is driven by a 3-horsepower, 60-cycle, 220-volt alternating-current Westinghouse induction motor. The machine may be used as a circular saw and also as a boring machine by means of an attachment. It is made in two sizes, light and heavy, the former suitable for driving by a three inch belt, and the latter by a four inch belt, the belt in each case running over a 3-inch pulley operating a saw 14 inches in diameter for ripping hard lumber. The frame is made of heavy angle steel, strongly braced, with overlapping corners securely belted together. A long substantial wooden base, one on each side, greatly increases the steadiness of the machine, giving more foundation and distributing the strain over the floor area. Angle steel clips are provided on the timbers for holding the machine to the floor. A saw table is made of angle and channel steel ground



to a uniformly level and true surface. The angle steel side table affords a substantial support, on which to bolt wood extensions of any width or length for work. The table is hinged at the back and so as to permit its being lowered or raised. It is provided with an adjustable depth cut having an opening for a 14-inch saw that will cut 5 inches deep. The machine can also be supplied with a boring attachment which can be used for routing, mortising and turning rosettes. This consists of an adjustable sliding support to hold the material being bored and a chuck attached to the end of the saw mandrel. Holes are provided in the frame for this attachment which can easily be added after the saw has been installed.

The machines are designed for electric drive by motors of from 3 to 4 horsepower capacity. The motor is mounted on the floor and belted to the pulley on the shaft which is mounted on the base timbers. The motor shown in the illustration, herewith, is of the alternating current type with what is known as a squirrel cage rotor or revolving part. This type is particularly adapted to use in wood working plants because of the absence of moving contacts and the entire elimination of any danger of fire from sparking. The motor requires absolutely no attendance, beyond an occasional oiling, and may be started and stopped from any point that is convenient to the operator.

Three Heat Cord Switch



There are many electric heating devices now on the market that are designed to operate at several "heats." Such devices as electric water urns, chafing dishes, heating pads, frying pans, table stoves, tailor's irons, etc., are advantageously operated under varying conditions at a low heat, medium heat and high heat. For the convenient control of these devices the Cutler-Hammer Mfg. Co. have augmented their line of feed-through or cord switches by the addition of a three-heat brass shell type as shown in the accompanying illustration and which can be placed on the cord in the most convenient location for operation. There are two push bars each having a light and black button which operate twin mechanisms so arranged that the pushing of one light button alone gives low heat, while the other white button, operated alone, gives medium heat. The shell is plainly marked so that the operator may know which button to press for low and which for medium heat. To get high heat both are pushed. The operation is positive and snappy, and one hand only is needed for the manipulation of the push buttons. As can be seen from the illustration two-conductor cord is required to connect to the socket or receptacle and three conductor cord is needed to connect the switch to the heating device. The brass shell is finished in polished nickel. The rating of this new three-heat switch is 6 amperes at 125 volts or 3 amperes at 250 volts.

The Canadian Union Electric Company, Limited

The Canadian Union Electric Company, Limited, have opened an office in Toronto at 122 Wellington street west, which will be under the personal charge of Mr. Allan B. Wearing, the managing director of this company. They will carry in Toronto a complete stock of motors, arc lamps of all descriptions and other electrical equipment. This firm make a specialty of scientific illumination as applied to factories, stores and large outside areas, using either the direct, indirect or semi-indirect system, as best suited to the conditions. A particular feature of their indirect and semi-indirect system is that they use an arc lamp instead of the

usual tungsten or carbon. This arrangement not only has the advantage of lower cost in operation, but is claimed to give an effect more nearly equivalent to daylight than any other form of illuminant.

In addition, the Canadian Union Electric Company will also undertake the supply of complete electrical equipments for power plants of all descriptions.

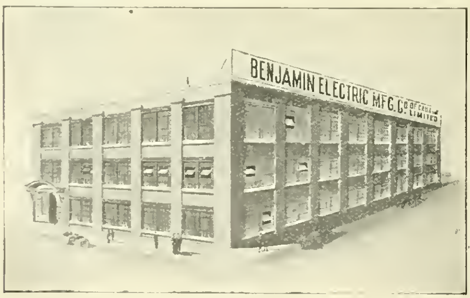
For the Customer's Convenience

The accompanying cut illustrates a paste board box in which all Pass & Seymour equipment is now shipped. The cut shows a band extending around the centre of the box. This band is a seal, placed there so that the customer can

see at once whether the box has been opened. In filling an order it saves him the time of opening the box to see if someone has removed any of the contents. If the seal is intact it is at once known that the box contains the quantity called for by the label.

New Benjamin Factory

Among the many United States companies which have opened factories in Canada few have shown such rapid growth as the Benjamin Electric Mfg. Co. of Canada, Ltd. Starting manufacturing in a small way in 1906 they have three times outgrown their quarters and finally have built a fine plant of their own at 11-17 Charlotte street, Toronto, where they are now located and manufacturing on a larger scale than heretofore. Everyone knows of the rapid growth of the electrical business in the Dominion and the demand for "goods made in Canada." The Benjamin company in



addition to their new building have added a great quantity of new and modern machinery so that they are now in a position to manufacture in Canada material and devices which heretofore have not been made in the Dominion but which had to be imported. This means a great deal to the electrical trade in the way of shipments and will do away with the many inconveniences experienced in importing goods from other countries.

The new building, shown herewith, is of mill construction and has approximately 30,000 feet of floor space. One of the main points considered was that of sufficient and proper light both by day and night. As will be noted from the above cut every inch available was given to window space. For night illumination two types of lighting equipment are installed, one, of the deep bowl type, in the stock rooms and assembly departments, with the shallow type in the machine shops. Benjamin Reflector Sockets are used in this equipment and it is a noticeable fact that it is unnecessary in any instance to use individual drop cords over any machine. As a result both the quantity and the quality of the work will be increased and the products of this factory will be those of skilled workmen operating at all times under the most favorable conditions.

The engineering department of the company is developing and getting under way complete lines of standard devices so that within the next few months the Canadian electrical trade will be able to purchase practically all of their electrical devices "Canada Made." Mr. George C. Knott is the general manager of the company; Mr. Morgan P. Ellis, sales manager; Mr. S. T. Faram, superintendent, and Mr. H. E. Bullis, factory manager.

Northern Electric-Sturtevant Vacuum Cleaners

The Northern Electric and Manufacturing Company, Limited, have recently been appointed sole agents in Canada for vacuum cleaners manufactured by the B. F. Sturtevant Company, and in conjunction with this latter company have developed and brought out a complete line of portable and stationary types of Northern Electric-Sturtevant vacuum cleaners, covering all classes of vacuum cleaning work. The Northern Electric-Sturtevant cleaners are built on the well known Sturtevant fan principle, one of the chief features of the complete line being its extreme simplicity, without

any delicate and carefully adjusted parts liable to get out of order. The only moving part of the cleaner is the fan, which is of strong construction and attached to the end of the motor shaft. The high speed motor in conjunction with the fan creates a very strong, powerful, and even suction. This is as strong as the fabrics of carpet and upholstery can stand without injury. On all these cleaners the dust bag is entirely enclosed, making a much neater machine, and overcoming any possibility of the dust being circulated around the room. The line comprises five portable types, from the smallest machine for household use, to the large portable type for large hotels and public buildings. There are also three types of stationary cleaners which have been standardized, and which are adaptable for residences and small public building work. For large public buildings, large offices, and railroad work special machines will be estimated on.

Cabinet-Type Motor-Driven Flasher

A distinct advance in flasher construction has recently been brought out by the Reynolds Electric Flasher Mfg. Co., in the form of a compact, enclosed-in-iron-cabinet, simple and reliable motor-driven flasher as shown in the accompanying illustration. The open cover shows the inner parts which consist of a power motor specially built for this work, a train of gears, a revolving brush, four contacts and the necessary fuses and terminals. The only moving current-carrying member is the brush which reduces the wear and tear and liability for trouble to a minimum. With this method an unusually quick make and break is obtained so that loads up to ten amperes per contact are handled with little or no arc. This equipment meets all underwriters' rules. The size of the flasher is 10½ in. x 9½ in. x 5½ in. so that it requires a very small space for installing.

The "Nulite"

Ever on the alert to give their many customers the best value that can be had for their money, The Canadian Tungsten Lamp Co. announced in our last number the introduction of their latest tungsten lamp which they have very appropriately christened the "Nulite." Made of pure tungsten drawn wire and with a continuous filament, they claim they now have a tungsten lamp that may be handled with as much impunity as a carbon lamp, thus eliminating the former objection to tungsten lamps that they are easily broken in handling. Two years of experiment have been spent to get this result, involving a large amount of worry, labor and expense on the part of the manufacturer, in order that the consumer may be supplied with the best that science can produce. Increased efficiency in service is, evidently, the keynote of this enterprising company's work and their large list of satisfied customers testifies to what extent their efforts are being appreciated by the dealer and consumer throughout the country.

Northern Electric Personals

The annual General Conference between the general staff and district managers of the Northern Electric and Manufacturing Co., Ltd., was held in Montreal from Dec. 2nd to 4th. The conference, which was most successful, terminated with a dinner and theatre party on the evening of Dec. 4th.

Mr. W. J. Doherty, supply sales manager, has been appointed to the office of the Jovian Statesman for the district of United States and Canada, for the year ending Oct. 15, 1913.

Mr. A. D. Smith, of the railway department, left recently on an extended business trip which will likely take him as far west as the Pacific Coast.

Mr. L. A. Burdick, of the Calgary house, has been elected Statesman of the society of The Rejuvenated Sons of Jove, which was recently organized there.

Mr. W. F. Uhl, of the specialty department, at Winnipeg, left recently for a brief visit to his home in Iowa. From there he goes to Montreal to join the sales staff of the Imperial Wire & Cable Company.

Mr. E. B. Beemer has been appointed head of the wiring specialties and house goods department at Winnipeg, taking the position of Mr. E. A. Lowden, who recently resigned.

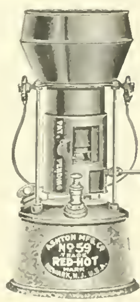
The Winnipeg house of this company has commenced a series of educational meetings which will be held bi-weekly during the winter. These meetings are attended by the sales, service and stock room staffs. The object of the meetings is to familiarize the men more thoroughly with the various lines of merchandise the company are handling as well as to acquaint them with sales methods. The first meeting was held on the evening of October 30th, with twenty-five present. H. C. Bentz, district sales manager, presided. He explained the object of the meetings and gave a general idea of what was expected to be accomplished by them. The second meeting was held on Wednesday evening, November 13th, with twenty-seven present. On this occasion H. F. MacGuyer, sales representative of the D. & W. Fuse Company, Providence, R. I., was present, and gave a sales talk on the "D. & W." lines.

Westinghouse Turbo-Alternators

The Railway and Lighting Department of the Canadian Westinghouse Co., Ltd., of Hamilton, Ont., have issued a booklet descriptive of Westinghouse turbo-alternators. The booklet outlines the history of the steam turbine and its development during the past 17 years. This company makes a specialty of a combined impulse and reaction turbine in which an impulse wheel is substituted for the smallest section of reaction blading, a design not claimed to give greater efficiency so much as that it reduces the length of the machine materially and gives a stiffer design of rotor. This type of turbine is fully illustrated and described in its three varieties—the single flow, the double flow, and the semi-double flow modification. The various parts of a turbo-generator and auxiliary governing equipment are also carefully described.

Torches and Fire Pots

A catalogue has just been issued by the Ashton Mfg. Co. of Newark, N. J., makers of gasoline torches and fire-pots for all mechanical purposes. Particular attention is given in this catalogue to a new kerosene fire-pot just placed on the market by this firm. It is claimed for this fire-pot that kerosene, as fuel, is less expensive than other things and is always obtainable. A perfect blue flame of intense heat is guaranteed. The tank is made of heavy galvanized iron thoroughly braced, and the burner is fitted with needle and packing nut, giving the operator perfect control of his equipment. The accompanying cut illustrates the kerosene fire-pot.



Browett-Lindley Canadian Agency

The John McDougall Caledonian Iron Works Company, Limited, of Montreal, have been appointed exclusive agents for Canada for the high-speed steam engines built by Browett, Lindley & Company, Limited, of Manchester, Eng. The "Browett-Lindley" enclosed, forced lubrication, double-acting engines are simple in construction, and, owing to the efficient system of lubrication and perfect balance of the moving parts, run silently and steadily under all conditions of load. This company has made a specialty of building engines for driving dynamos since the earliest days of the electrical industry. The "Browett-Lindley" is in use in the largest electric light and tramway stations, as well as in the most important collieries, steel and iron works, cotton and paper mills, etc., in England, and has earned an enviable reputation for economy and high efficiency.

The Automatic Surveyor Level

Among the new improvements being brought to the attention and use of the engineers of to-day, is the new Automatic Surveyor Level, recently invented by M. J. Dikeman, of New York City. This Automatic Level will not only take the grades, but will measure the horizontal distances, establish stations every 50, 100 or 200 feet, as desired, and produce a complete profile map of the line of survey. It is claimed that its design is so complete that it will do the work of the entire levelling party. These instruments have been under construction for several years, many designs being built before a perfect machine was obtained. While the instrument is quite complicated, the working and operation is very simple, and the entire work is accomplished by one man, in less than one-tenth of the time required by the usual surveying party; and without the liability of error or mistake.

The level is an electrical instrument, mounted on a suitable vehicle, and after the record sheet is placed on the rolls, the instrument being adjusted or levelled, is ready for work, the entire record and data being taken by drawing the vehicle over the line of survey, making an instantaneous record of every thing over which it passes.

The principle upon which the instrument is designed, is based on the law of gravity. The various motions required to produce the records, are mostly obtained through the use of friction discs, governed and controlled by an electrical device, which increases, decreases, and reverses the motion regulating and controlling the recording device. The capacity of the level is from 15 to 20 miles per day, depending upon the condition of travel, and the roughness of the ground to be passed over. It is especially adapted to the preliminary surveys on any class of work and will be of great value in irrigation and railway work, although it is equally as well adapted to the usual classes of city work in paving, sewers, and general work. These instruments are being manufactured by the Dikeman Surveyor Company, of Detroit, Mich.

Eclipse Electric Cookers

The Electric & Ordnance Accessories Co. Ltd., have received an order from the Westminster Electric Supply Corporation, Ltd., of London, England, for 50 Eclipse cookers of a new pattern, these cookers being intended for hiring-out purposes. Designs were submitted by a number of other cooker manufacturers, and the contract was placed after severe tests.

The Electric & Ordnance Accessories Co., Ltd., are represented in Canada by Messrs. Canadian Vickers Ltd., office, 20 Bleury street, Montreal.

Order for 15000 Kw. Turbo Generator for Manchester

The Siemens Company of Canada have recently received an order from the Manchester, Eng., Corporation for one 15,000 kw. turbo-generator, 3-phase, 50 cycles, 6600 volt, 1000 r.p.m., to be direct coupled to a Zoelly turbine manufactured by Messrs. Howden & Company. The Siemens company have already delivered four turbo-generators to the Manchester corporation with outputs of 4500 kw., 6000 kw., 6000 kw. and 7500 kw. respectively, and this new order serves to show the satisfactory operation of their apparatus. This company have built over eighty turbo-generators with an output of 4000 kv.a. or over, among which is one having a continuous output of 21,500 kv.a.

The wording of the franchise which it is proposed to give the Stratford Railway Co. in the city of Stratford, Ont., has been revised again and, it is said, is practically agreed upon by the two parties. It is being submitted to the ratepayers at the New Years' elections.

Ignition and Lighting Sets

"Westinghouse Electric Ignition and Lighting System" is the title of a handsome catalogue just issued by the Westinghouse Electric & Manufacturing Company, describing and illustrating in detail the new ignition and lighting system for gasoline automobiles recently placed on the market by this company. The book has an attractive art cover, and is printed by the off-set process. Complete detail views, together with diagrams are given of the apparatus, as well as a thorough description of the methods of construction of same. In addition to the ignition and lighting sets, a number of other automobile accessories, manufactured by the company, are described, such as the vibrating rectifier, automobile tire vulcanizer, and wiring details used in connection with the ignition set.

Aluminium

The British Aluminium Co. of 109 Queen Victoria street, London, E.C., have issued a booklet called "Aluminium" which outlines the use of this metal in a number of different industries, e.g., the automobile industry; in aerial navigation; in the electrical industry as cable, busbars, and switch board connections; in the railway field and in many miscellaneous ways. The same company are also distributing reprints from the Electrical Review and Electrical Engineering together with letters from prominent engineers, explaining the characteristics of copper and aluminium in transmission line work and the entire satisfaction given by aluminium in installations made by these engineers.

Attractive Advertisements

A new feature in advertising electric appliances and other equipment has just been introduced by the Ottawa Electric Company. Big posters displaying electric irons, electric heaters, etc., have been posted on the bill boards in the city. There is a picture of a girl with her hand on a switch showing how all the articles can be operated, if so desired, by this one switch on the light bracket. At night two powerful electric lights, hidden under reflectors, show the posters up to advantage.

Low Frequency Flicker Cured by Two-Phase Wiring

The Electrical World quotes an instance of a large factory in which the lighting from the 25 cycle two-phase mains gave considerable annoyance by its flickering. A way out of the trouble was found by wiring half the lamps on one phase and half on the other, The peak of one phase coincided with the valley of the other, and the flickerings neutralized each other, with the result that no unevenness in the illumination on the working plane could be detected.

Dissolution of Partnership

The firm known as Vandeleur & Nichols, comprising Mr. J. B. Vandeleur and Mr. R. H. Nichols, is in process of dissolution. The business, however, has been actively managed by Mr. Nichols for the past few months, and it is the intention of Mr. Nichols to carry on business in the same lines as heretofore.

H. W. Johns-Manville Company

The H. W. Johns-Manville Company have recently opened a new southern warehouse in Atlanta, Ga. The entire building, embracing three floors and a basement, with a total floor area of about 10,000 square feet, will be utilized exclusively as a warehouse for a stock of such J-M products as roofing, boiler and pipe coverings, cements, packings, fire extinguishers, electrical, railway and automobile supplies.

West Lorne Installing a Gas Producer

The West Lorne Electric Light Co. have been granted a twenty-five year franchise by the town and expect to have a practically new plant in operation by February 1, 1915. A new 65 h.p. type R. multi cylinder producer-gas engine is being installed which will drive a couple of small d.c. generators already in the power house. The producer is a Fairbanks Morse, of the suction type and will be arranged for belt connections to the line shaft. At the outset the plant will be used for illuminating purposes only, but it is hoped later on to give a 24 hour service.

Smart-Turner Pumps

The Smart-Turner Machine Co. of Hamilton, Ontario, are supplying duplex pumps to Mr. Wm. Bermingham, Goderich; The Pratt & Whitney Co., Dundas; Mr. Stephen Wellington, M. E., Madoc; and the Breslau Brick Co., Breslau, Ont. The same company are also installing at the present time a rotary pump for Mr. W. A. Mustard, Baysfield, Ont., and a centrifugal pump to Mr. L. H. Couillard, East Angus, Que.

The Stone & Webster Corporation who are constructing the street railway system in Saskatoon and who have also drawn plans for a railway system in Prince Albert now have their auditor in Saskatoon working out a system of bookkeeping by which the street railway operation can be taken care of along with other municipal enterprises with the least possible friction.

The gas producer seems to be coming into its own, although development along these lines is slow. The tremendous increase in the price of fuel oil has been a great factor in bringing the producer to the attention of a great many people who use gas for both fuel and power purposes.

The Bell Telephone Co. have submitted a proposition to the London city council offering $4,000 a year and $600 worth of free telephones for a three years' renewal of their exclusive franchise.

The ratepayers of Ward 7, Toronto, are asking the city council to make application to the Ontario Railway and Municipal Board for an order compelling the Toronto Railway Company to build a line on Bloor street, west from Dundas street to Quebec avenue.

Preliminary surveys have been made for an electric railway to connect Taber, Alberta, with certain coal mines in the neighborhood and it is said a charter will be applied for in the near future by a number of Calgary men.

The Telkwa Light and Power Co., Ltd., has been incorporated with the usual wide powers. The head office of the company is Victoria.

Trade Publications

High tension fuses: Bulletin No. 1 issued by the Delta-Star Electric Co. of Chicago, descriptive of S. and C. high tension fuses.

Flashers:—Bulletin No. 24 issued by the Reynolds Electric Flasher Manufacturing Co. of Chicago and New York, descriptive of their cabinet type flasher.

T. T. C. Equipment—The Tungstolier Co. of Canada has recently issued a catalogue covering their line of T. T. C. tungstoliers. This catalogue will be found of unusual interest to the dealer or contractor interested in illumination.

Governors—The Escher Wyss & Co. are distributing from their Montreal office, a pamphlet describing their universal oil-pressure governor for water turbines. This pamphlet deals particularly with sizes for small and medium size turbines.

Supply Catalogue: Section 4, second edition issued by the Canadian General Electric Co., Ltd., of Toronto, descriptive of snap, flush and knife switches. The catalogue contains 76 splendidly illustrated pages of descriptive matter on this apparatus.

Blue Printing: A booklet issued by the C. F. Pease Co., 166 West Adams street, Chicago, describing blue print machinery, blue print room supplies, direct white print machinery, drafting room furniture and supplies as manufactured by this company.

Insulators: Booklet issued by T. C. White, manufacturer, St. Louis, descriptive of porcelain strain insulators. This booklet shows cuts, with descriptions, weights, dimensions, tests, etc., of the improved type of porcelain insulator manufactured by this company.

Electrical Books.—The D. Van Nostrand Company, of 25 Park Place, New York, have just issued a new catalogue of their books on electricity. The books are classified by subjects and appear to cover very thoroughly, the whole range of electrical knowledge and practice.

Presto: A booklet issued by the Pass & Seymour, Inc. of Solvay, N.Y., suggestive of the advantages to be gained by using P.&S. interchangeable sockets and receptacles. From fifteen parts it is possible to make up twenty four different combinations of sockets or receptacles. The methods of interchange are shown by a clever illustrated device.

Westinghouse: The Westinghouse Electric & Manufacturing Co. of East Pittsburgh, Pa., have recently issued the following; sheet 2411-A outlining points of importance in selecting and applying small motors; a booklet entitled "The Westinghouse Sewing Machine Motor;" a booklet entitled "Electric Ware," describing, with illustrations, the various household equipments manufactured by this company; a booklet entitled "A.C. watthour meters;" a booklet entitled "Westinghouse motors;" the Textile Quarterly No. 2 published by the Industrial and Power Department, describing motor drive for worsted and woollen looms; publication No. 1203 descriptive of their electric ignitor and lighting system for automobiles; sheet No. 2485 describing Westinghouse low pressure turbines.

New Books

Alternating-Current Machinery, by William Esty, S. B., M.A., Head of the Department of Electrical Engineering, Lehigh University. American School of Correspondence, Chicago, publishers. 475 pages, well illustrated. This treatise has been prepared with the special object of giving the beginner, and the practical engineer who has not had the advantage of a technical training, a working knowledge of alternating machinery and how to install and operate it. The reader is assumed to have some knowledge of the elementary laws of electricity and magnetism but practically all the higher mathematics has been omitted and graphic methods have been adopted wherever possible. The subject matter is treated under the following heads.—alternating-current principles, measuring instruments, alternators, synchronous motors, transformers, conversion of a.c. to d.c., induction motors, switchboard and station appliances. There is no doubt that a close study of this book will go far towards fulfilling the object for which it was written and will add much to the useful knowledge of the reader and student.

Current News and Notes

Aurora, Ont.
The council has passed a by-law to purchase the equipment of the Aurora Electric Light Company.

Ashcroft, B.C.
Following a notice sent out by the Ashcroft Water, Light & Power Company that customers in future must come to the office to pay their bills by a certain date, and that no bills will in future be rendered a number of citizens who refuse to conform to the new rules were threatened with disconnection from the service. One of the customers seeks an injunction to restrain the company from carrying out its alleged threat.

Acton, Ont.
A by-law is being submitted on January 6th to authorize the issue of debentures to the extent of $8,500 for completing the distribution system.

Bobcaygeon, Ont.
The village electric light power house was destroyed by fire recently. This was a small water power plant owned and operated by the municipality. The loss is estimated at about $5,000, which includes the generators.

Chesterville, Ont.
A power and lighting system is contemplated.

Cobalt, Ont.
A by-law to raise $60,000 to cover cost of plant extension and distribution is being submitted.

Cornwall, Ont.
A by-law was submitted on Monday, December 23rd, asking approval of an agreement between the town of Cornwall and the Stormont Electric Light and Power Co. The company agrees to install and operate two hundred 110-volt, 75-watt tungsten lamps for $2,000 a year or at the rate of $10 each, lights to burn from sunset to sunrise every night. The by-law provides that a ten-year franchise be given the company under these conditions.

Clinton, Ont.
A by-law will be submitted at the New Year elections to raise $33,000 to purchase the Clinton electric light plant and erect a transformer station. Power will be obtained from the Hydro-electric Power Commission of Ontario at $39 per h.p. on the supposition that a number of towns in the district take 1,500 h.p. between them.

Chatham, Ont.
It is reported that Mr. D. A. Gordon, of Wallaceburg, has taken over the Chatham, Wallaceburg and Lake Erie Railway. It is further reported that the purchase has been made for the C. N. R.

Calgary, Alta.
Property owners in certain suburbs of this city have offered to build an extension of one and one-half miles to the Manchester street car line at their own expense and make a present of it to the city, the only condition attached being that the city will operate cars on it. The proposed agreement also protects the city against any loss incurred by operation of the lines during the first three years.

Commissioner Graves has made the interesting report that by using natural gas under their boilers instead of coal at $3 a ton, a saving of between $25 and $30 per day is made in Calgary's fuel bill. The city is under contract with a natural gas company to take 10,000,000 cubic feet of gas per month at 15c per M.

It has been recommended that a water tower be erected near the reservoir and a motor-driven turbine pump installed.

Dauphin, Man.
Councillor Malcolm is advocating erection of cluster lights on the main thoroughfares.

The town council recently decided to install a new plant with three times the capacity of the present equipment which is at present overloaded. It was suggested that the exhaust steam be used for heating purposes.

Dryden, Ont.
A by-law has been introduced in council to take over the electric lighting system of the Dryden Timber and Power Company, and run it as a municipal proposition.

Esquimalt, B.C.
A contract has been closed with the B. C. E. R. Co. to supply lights and power for street illumination in this village. The terms of the agreement permit the municipality to pay for the work in five equal annual instalments with interest at 6 per cent. The B. C. E. R. Co. will install a system capable of supplying 250 lights, though all of these will not be installed immediately.

Fort William, Ont.
A strike is threatened on the Port Arthur and Fort William Electric Railway System.

Galt, Ont.
At the January elections Galt will elect a hydro-electric commission to have charge of electrical matters here. This is in accordance with a recent Provincial Act, giving municipalities power to make such appointments.

A movement is on foot to illuminate the road connecting Galt and Preston, a distance of about two and one-half miles. The Galt, Preston & Hespeler Electric Railway line follows the road it is proposed to illuminate.

The Brantford & Hamilton Railway Company, a subsidiary of the Dominion Power and Transmission Company, has given notice that it will apply for authority to construct a railway line from a point near Langford to a point in or near Galt.

Gananoque, Ont.
Notice of application will be made to next session of Legislative Assembly of Ontario for an act to incorporate F. A. Henry, R. A. Sibbitt, J. C. Judd, all of Ottawa; W. T. Sampson, Gananoque, J. A. Donevan, Toronto, F. B. Taber, Morton, and D. W. Green, Lyndhurst, under the name of the Gananoque, Perth & Lanark Ry. Co., company to construct and operate line to use steam, electricity or other motive power between Gananoque and Lanark, with branch from near Morton through Lyndhurst and Delta to Portland.

Halifax, N.S.
The city is making a three-year contract with the Halifax Electric Tramway Company to provide street lights at a rate of $60 per arc light.

It is proposed to ask the Provincial Legislature to interfere in behalf of the city in the latters attempt to regain control of the electric railway franchise. The city is now eager to buy out the railway system and operate it as a municipal enterprise.

Humboldt, Sask.
A contract has been awarded for power house equipment as follows: engine and boilers, E. Leonard & Sons; electrical equipment, Canadian General Electric Co. Chipman & Power, Mail & Empire Bldg., Toronto, are consulting engineers.

Hamilton, Ont.
Negotiations are in progress between the Hamilton Street Railway Company and the city, which may result in the increase of the present track mileage by about fifty per cent.

The Hamilton Street Railway Company has been requested to build certain extensions in various parts of the city. If the company declines to make these extensions it is suggested that the city may build them.

Street railway employees have accepted the following offer of the company: 20c, 22c and 25c per hour respectively for the first three years with 2c extra per hour for over time.

It is announced that the city is already using more than the 2,000 h.p. contracted for and Mr. H. C. Barber, manager of the system, has been instructed to make application for 1,000 h.p. more.

Kamloops, B.C.
Tenders are called for 1,000 h.p. steam pumping and electric equipment.

Kingston, Ont.
In the event of the Street Railway Co. not being able to come to satisfactory terms for the renewal of the contract for a supply of power to operate the railway, it is reported that the company will install a steam plant of their own. At the present time power is purchased from the city at the rate of 1.2c. per kw.h.

Mr. H. W. Richardson, President of the Kingston, Portsmouth and Cataraqui Railway Co., has advised the representative from the joint committee of Utilities and Board of Works that this road is not for sale. Recently the city of Kingston decided to open negotiations re the purchase of this road to be operated as a municipal enterprise.

London, Ont.
Owing to strenuous opposition on the part of business men, the city council

have decided to allow the by-law dealing with the electrification of the London and Port Stanley Railway to stand over. It was the original intention to submit this by-law on January 1st.

It is said surveys will start at once for new radial lines between London, St. Mary's, Sarnia, Chatham and Windsor.

Following the objection raised by one of the aldermen that the sum of $30,000 was too large an amount to pay for street lighting, Prof. Angus, of the University of Toronto, has made a report in which he names $19,000 as a reasonable sum.

Lethbridge, Alta.

Operating figures to date of the Lethbridge street railway system recently handed out by Superintendent Arthur Reid show that for the first eighty-four days of operation the total earnings were $15,159, or a daily average of $182. As the daily expense of operation, including interest and sinking fund is placed at only $190, it is hoped that the first year will easily see the system carrying its own charges. The new turbo-generator is reported to have been started up during the early part of December.

Moose Jaw, Sask.

City Engineer Antonisen, following his return from a trip of inspection of a coal property some forty miles south of this city, has stated his belief in the possibilities of cheap electric power from this point. The natural plan would be to construct a development plant in the coal fields and transmit energy at a high voltage to the city.

In a report recently made by Mr. B. F. Haanel, Ottawa, on the coal deposits in the neighborhood of Moose Jaw, it is stated that this lignite is particularly well adapted for use in a producer gas plant.

Montreal, Que.

Plans of the location of the ornamental light standards on St. Catherine St. from Papineau to Atwater ave. were submitted to the Board of Control by Superintendent Parent of the city Light Department. The plans call for 142 standards.

North Bay, Ont.

A by-law is being submitted, asking power to borrow $60,000 for electric distribution system.

Niagara Falls, Ont.

It is said the Electric Light Commission of this place will lay in a stock of tungsten and carbon incandescent lamps and the various articles of household equipment to be sold to users of electric power at cost.

The Niagara Falls Queen Victoria Park Commission have given permission to the Ontario Power Company to enlarge power house and install two more units of 13,500 h.p. each, including turbines, generators, governors, switchboard, penstock, etc.

Nelson, B.C.

It is said the street lighting system here will be in operation by the beginning of the year. Three light standards are being installed.

Owen Sound, Ont.

A by-law will be submitted at the New Year to authorize the issue of $50,000 debentures to meet an overdraft and to cover needed extensions at the electric light plant. It is suggested that automatic stokers be installed and low pressure steam turbine to operate by exhaust steam.

Ottawa, Ont.

A by-law is being submitted to authorize the Ottawa Electric Railway Company to construct certain extensions to their line.

Orillia, Ont.

A by-law will be submitted providing for the placing of the municipal enterprise under a Water, Power and Light Commission.

Parry Sound, Ont.

A by-law to raise $5,500 for altering and improving the electric light plant, is being submitted.

Port Arthur, Ont.

The city council has recommended the purchase of four pay-as-you-enter cars for their main line.

A by-law is being submitted to expend $12,000 for the purchase of a motor-generator at Port Arthur. A by-law is also being submitted, asking authority to issue debentures for $6,550 for extensions to the lines of the street railway system.

Port Colborne, Ont.

The Ontario Power Company is constructing a one-storey, 35 x 75, concrete foundation, steel and brick construction, sub-station here.

The Ontario Power Company has promised to readjust the electric lighting rates after the new year.

Port Dalhousie, Ont.

A by-law is being submitted, authorizing the appointment of a Light and Heat Commission to manage the reception, distribution and supply of electric power.

Peterboro, Ont.

A by-law is being submitted to the ratepayers on January 1st, authorizing the expenditure of $120,000 on a municipal lighting system.

Prince Albert, Sask.

The by-law to expend three-quarters of a million dollars on a hydro-electric power proposition is being again submitted to the electors owing to some little technicality that was formerly overlooked.

Port Alberni, B.C.

Contract has been awarded for one Diesel oil engine to Mather-Yuill & Co., 429 Pender street, Vancouver, and for one 100 kw. generator and switchboard to the Canadian General Electric Company.

Quebec, Que.

The Board of Conciliation has been instrumental in settling the wage dispute between the Quebec Railway Light, Heat & Power Company and its employees. First year men now get 17½c., second year 18½c., third year 20½c., eight year 21½c., thirteenth year 22½c. per hour. After November 1st, 1913, this schedule is increased 1c. per hour all round.

Revelstoke, B.C.

The Revelstoke City Council have decided to proceed at once with the installation of an arc lighting system stretching for about two miles from the C. P. R. station to Columbia River bridge.

Rosthern, Sask.

A by-law will be submitted to raise money for the installation of an electric light plant.

Richmond Hill, Ont.

The Toronto and York Radial Railway Company will supply this village with a street and house lighting service. Yonge street will be lighted with twenty-six 80-watt tungsten lamps. It is understood the work of installation will be done by the town and the company agrees to supply power at the rate of $26.50 per h.p. year. It is proposed to make a charge of 8c per kw. hour for house lighting. Considering that this town is some 110 miles from the source of supply a $26.50 rate for 50 h.p. would seem to be a specially favorable one.

St. Thomas, Ont.

The Commission reports that this city will show a surplus anywhere between $15,000 and $20,000 on the year's operation of hydro-electric light and power.

By-law is being submitted to ratepayers in January to expend $18,000 on street railway extensions.

Souris, Man.

By-law is to be submitted to expend $40,000 on an electric lighting plant.

St. Mary's, Ont.

The Water, Light & Heat Commission have complained that the rates charged the city by the Hydro-electric Power Commission of Ontario are too high, and state that power is being furnished at a lower rate to a private company in St. Mary's. An attempt will be made to obtain the same rate for the city as the private company is receiving.

The council is considering making an offer to its customers to allow each house to install one verandah lamp not over 55 watts capacity, for which no charge will be made for operation.

Stratford, Ont.

A new power line from Stratford to Sebringville is contemplated and plans and estimates will be prepared soon.

A street railway by-law will be submitted to the electors on January 6th. The company agrees to obtain its supply of power for the operation of the railway from the Hydro-electric Power Commission, provided the rates are as favorable as those obtainable elsewhere.

St. Catharines, Ont.

The city council has reconsidered its refusal to negotiate with the Hydro-electric Power Commission and will ask an estimate on cost of 2,000 h.p.

Toronto, Ont.

The Northern Electric & Mfg. Company, Ltd., have awarded to Clarke & Monds, 152 Bay street, a contract for factory and warehouse as follows:—cement foundation, reinforced concrete, brick, structural steel construction, concrete floors, felt and gravel roofing, metal sash, metal lath, gas and electric lighting, steam heating, vaults.

The Board of Control have asked Commissioner Harris to make a report on

the purchase by the city of six civic busses.

The Board of Control has passed a recommendation to install ornamental street standards on Victoria street.

Thirty-five members of the sales department of the T. E. L. Co. held a banquet recently at which Mr. P. H. Kemble, chief of the department, addressed the members on "The Policy of the Company."

The Hydro-electric Power Commission of Ontario and their chief engineer, Mr. F. A. Gaby, are actively carrying on negotiations looking to the extension of their line west from St. Thomas to Windsor.

Vancouver, B.C.
Following negotiations between the parties concerned it has been decided that the B. C. E. R. Co. will be given special rights on B. C. Telephone Company poles on car line streets. This is intended to do away with as much extra pole construction as possible. It is understood the Telephone Company is prepared to sell the Railway Company a half interest in the poles.

Wallaceburg, Ont.
The Chatham, Wallaceburg & Lake Erie Electric Railway Company contemplate extensions to the electric lighting system of town.

Windsor, Ont.
An agreement has been signed with the Hydro-electric Power Commission of Ontario for the supply of 2,500 h.p. at a rate not to exceed $38 per h.p. This rate is given on the supposition that power will be required by a number of towns and municipalities in the neighborhood. Work will be commenced on the line from St. Thomas to Windsor early in the spring and in the meantime, supplies will be put in hand.

Wilkie, Sask.
By-laws to raise $10,000 for electric power plant extensions and $2,250 for extending the electric light system, passed recently.

Weyburn, Sask.
A by-law has been approved to expend $35,000 on additions to the municipal electric light system.

Winnipeg, Man.
An extensive railway scheme brought forward by the Porcupine Rand Belt Electric Railway Company, proposes plans to build a line connecting Winnipeg with Quebec city. In Quebec and in Ontario as far west as Lake Nipigon, it is proposed to locate the line between that of the G. T. P. and the C. P. R. From Nipigon west, it will lie south of the G. T. P. and north of both the C. N. R. and the C. P. R. It is stated that 75 miles of the road is to be surveyed this fall. The first section of the line to be constructed if this scheme goes through, will probably be from Larder city east to the Quebec boundary. In all probabilities self-contained cars would be used and there is some talk of storage batteries.

The Northern Electric & Manufacturing Company have been awarded the contract for thirty fire alarm boxes.

Tenders will be received until January 6th, by the Secretary of the Board of Control, for a supply of 500 to 1,000 electric flat irons.

The Winnipeg Electric Railway Company will likely be asked to make a proposal for extension of its Headingly line to Portage la Prairie.

Tenders will be received by the Secretary of Winnipeg Board of Control until January 24, 1913, for supply of three step-down transformers, 2,700 kw. each.

Commissioner Robson has issued an order for the joint use and ownership of poles by the Winnipeg Electric Railway Co. and the city of Winnipeg.

Yellow Grass, Sask.
Town will install complete electric lighting and power plant.

Condensed Department

RATE

Positions Wanted, Positions Vacant, Miscellaneous. 2 cents a word per insertion.

Tender advertisements, equipment for sale, etc., 15 cents per agate line (14 agate lines make one inch) per insertion.

Advertisers who wish to conceal their identity may do so by using an Electrical News box number without extra charge.

Forms close on the 18th of each month.

Situations Wanted

Electrician open for engagement experience in wiring, operating and repair work. Best references; age 26. Apply Box 670, Electrical News, Toronto, Ont. 1

Position as Hydro-electric Power House Superintendent of small plant or assistant in larger plant. Ten years practical experience in care, maintenance and operation of power house and sub-station apparatus. Good technical education. Associate A. I. E. E. Best references. Box 659, Electrical News, Toronto, Ont.

Electrical Engineer, McGill graduate, seven years' experience with steam, hydraulic and internal combustion generating plants, operation and construction, wishes position as superintendent of power system or with consulting firm. Will go anywhere but prefer British Columbia. Salary $2,000 per annum. Reply Box 666, Electrical News, Toronto, Ont. 1-3

Situations Vacant

Draughtsman wanted, by Toronto Hydro-electric System, experienced on High and Low Tension, Sub-station Design. Good salary. Apply Station Department, 228 Yonge Street, Toronto. 1

Draughtsman First-class, experienced in Switch Gear for High Tension and Low Tension A.C. work for large Hydro-Electric Plant in Canada. Must be neat, accurate, capable and able to do designing and layout work under supervision. Also Junior on similar work. Apply to Toronto Power Company, Niagara Falls, Ont., Canada. 1-2

Car Ventilating Systems

The Vacuum Car Ventilating Company has commenced manufacturing Mechanical Car Ventilating Systems under Canadian Patent No. 128070, dated September 13, 1910, and is prepared to furnish same on demand. For detailed information and prices, address Lock Box No. 25, Windsor, Ont. 10-t.f.

Electrical News

Generation, Transmission and Application of Electricity

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Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

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The Working Out of the Hydro Plans

In accordance with powers granted at the last session of the local legislature, the Hydro-electric Power Commission of Ontario are gradually rounding into shape their comprehensive scheme of systematic control of the operations in the various municipalities served. This is true not only with regard to standardization of equipment and methods of installation, but also with reference to the rates levied for the different forms of light and power. This is a matter of extreme importance in the successful working out of this great undertaking and promises to remove one of the greatest and most universal enemies to the successful operation of municipal enterprises, viz., local politics. The need for such a move is all too apparent in certain quarters—profits in certain departments were being used to cover deficits in other departments or to reduce the general taxation rate; under the lash of competition, light and power was being sold below cost; street lighting was being charged at an unduly high rate, and finally the year-end promise of advocacy of cheaper rates, regardless of cost or consequences, was made the excuse for an appeal for the poor man's vote. These conditions were not rampant, fortunately, but their existence will not be questioned.

The course taken by the Commission to remedy these evils has been businesslike and systematic. Some months ago a uniform system of accounting was drawn up and arrangements made whereby every municipality could keep itself and the Commission in touch with expenditures and receipts in the various sub-departments of house lighting, street lighting, commercial lighting, power, etc., according to standardized rules. Periodically each municipality now makes a report to the Commission with the result that that body is in a position to ascertain at a glance the condition of any sub-department of any municipality's operation. To render this system of account keeping absolutely uniform it was necessary that the method of [illegible] should also be standardized and this is now the case.

The natural sequence to the working out of this accounting system is the control of rates and their scientific and frequent adjustment by the Commission, natural for two reasons. First, the officers of the Commission being entirely removed from the scene of local strife should have no object in treating each individual case other than on its own merits. Second, the Commission is able to maintain a staff of skilled engineers and accountants quite beyond the reach of the ordinary municipality. Each municipality, therefore, however small, reaps the benefit of the experience and advice of men of recognized reliability and skill.

The municipalities are quickly recognizing the advantages of such a well-balanced system and while there may have been, in isolated cases, a slight tendency to resentment at what may seem like depriving them of the management of their own affairs, this feeling is giving place to satisfaction in the recognition that each municipality's business is being better managed, and at less cost, than they could hope to do it themselves.

Electrification of Steam Roads

In this issue we print an article by Mr. N. W. Storer on the subject of electrification of steam roads. In view of the conditions existing in Canada at the present time, where plans are even now under discussion for changing from steam to electric operation, a paper of this kind is timely and valuable. The paper points out that it would be a great mistake to move too rapidly in the matter of the electrification of steam roads. The competition which electricity has introduced has roused the steam roads to special activity, with the result that marked improvements in operative conditions and in operation costs have been introduced in steam locomotives. As a result, the advantages claimed formerly for the electric locomotives are not so evident. The author further states that electric locomotive design is as yet more or less in the formative stage and has not reached that state of perfection that electric cars or other electrical equipment show. Mr. Storer takes advantage of the occasion to describe the different types of locomotives as to their design and various forms of drive, pointing out the advantages and disadvantages of each. It is made abundantly clear that varying conditions must regulate the design of the electric locomotive to a great extent if best results are to be obtained. It is necessary that each locomotive should be designed for its special requirements. Where the requirements are variable it follows that the efficiency of the electric equipment will not be so great.

Nor is the design of the locomotive the main consideration. Conditions of current supply, the location of sub-stations, the quantity of current to be used, depending on the size of the locomotive and the loads to be carried, are factors of prime importance in the determination of the cost of electrification. On account of the heavy current requirements sub-stations must be frequent and the [illegible] of carrying requirements for heavy service. It is claimed that 3,500 volts d.c. is the lowest possible [illegible] service on heavy locomotives, this on account of the heavy current requirements which would make the [illegible] voltage equipment prohibitive. [illegible] commercial possibility as far as the motor equipment is concerned. A brief review is given in the paper of a number of high voltage single phase systems [illegible] satisfactorily as high as 15,000 volts.

Cedars Rapids Equipment

As stated in our last issue, the Cedars Rapids Manufacturing and Power Company have closed a contract for the supply of twelve 10,800 horse power turbine units. These will operate under a head of thirty feet at a speed of 56 revolutions. The equipment will also include three 1,500 horse power exciter units for the same head, the speed of these being 150 revolutions per minute.

The design of these turbines will be very similar to that of the Keokuk plant, described in the September number of the Electrical News, the only real difference being that the weight of the rotor of the generator and of the revolving parts of the turbine will be carried on a thrust bearing above the generator instead of below, as is the case in the Mississippi plant.

This contract has been divided between the I. P. Morris Company, of Philadelphia, and the Wellman-Seaver-Morgan Company, of Cleveland. The I. P. Morris Company's contract covers the design, construction and installation of nine of the main units, the three exciter units and also the twelve main unit and three exciter unit governors with complete pump auxiliaries. The Wellman-Seaver-Morgan Company will construct three of the main units from the same design.

The water-wheel contract includes the turbine complete, the shaft running through the turbine and generator, the thrust bearing support or truss to be located above the generator, also the thrust bearing complete. The weight of the generator will be taken through cast iron supporting barrels through the turbine to the foundation below.

The main units will be of the single runner vertical shaft type and will be installed in wheel chambers of spiral shape formed in the concrete foundations of the power house. These water wheels will be the largest in size in the world. The exciters will be of the same type only smaller in size. The runners for these wheels will be an enlargement of a model runner which under test at Holyoke gave an efficiency of ninety per cent.

Mr. Nicholls is President

At a recent meeting of the directors of the Canadian General Electric Company, Mr. Frederic Nicholls, general manager and vice-president of the company, was elected president. Mr. W. R. Brock, the former president, was elected to the office of honorary president.

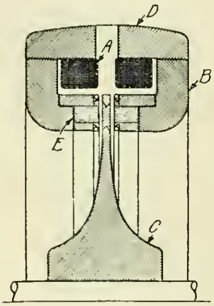
For more than a quarter of a century the Canadian General Electric Company and Frederic Nicholls have been synonymous terms. The tremendous growth of the company, financially, is shown by the latest annual report dated April 30, 1912, which places the assets at the enormous total of $15,522,253. This, compared with the original modest $10,000 capitalization less than thirty years ago, is indicative of the indomitable energy and splendid executive ability Mr. Nicholls has brought to his company's service through all these years. The success of the products of the company has been no less marked, for the C. G. E. trade mark on any piece of electrical equipment is recognized as standard the world over.

Single-Phase Motor, Pole-changing Windings

A new type of single-phase commutator motor recently installed in the James Watt Engineering Laboratories of the University of Glasgow was inspected by the members of the Institution of Electrical Engineers on the occasion of their recent visit to Scotland. The motor is described in a recent paper by Messrs. Nicholson & Haigh, read before the Institution. This motor, which is the invention of one of the authors, is intended for railway service, although the particular machine tested is only of small size and of open construction suitable for experimental work. The main difference between this type of machine and other commutator motors lies in the use of pole-changing windings.

Generating Apparatus for Wireless

The advance in high frequency generating apparatus for wireless telegraph and telephone work has now reached a point which a few years ago would have been considered an impossibility. Up to 1908 the highest frequency that had been produced was 10,000 cycles, but in that year Mr. E. F. W. Alexanderson, of the Consulting Engineering Department of the General Electric Company, produced an alternator built for 100,000 cycles. Mr. Alexanderson has now published details of a machine capable of generating with a frequency of 200,000 cycles, and a frequency of 400,000 cycles



Section high-frequency alternator

has been produced by the use of this same machine in combination with a mercury arc rectifier.

The standard 100,000 cycle alternator has 600 slots, and consequently the same type of winding for 200,000 cycles would require 1,200 slots. A new type of winding was devised which allows the use of two-thirds as many slots as the effective number of poles, so that in the 200,000 cycle machine 800 slots are employed. The alternator is of the induction type and is provided with a novel arrangement of the magnetic circuit allowing the construction of a rotor which can be operated at exceedingly high speeds. A semi-cross section parallel with the axis of this high frequency alternator is shown in the accompanying figure. The rotor, C, consists of a steel disk with thin rim and wide hub, shaped for maximum strength. The field excitation is provided by two coils, A, located concentric with the disk and creating a flux that passes through the cast iron frame, D, the laminated armature with its teeth and the disk. B represents the two armatures which are secured in the frame by means of a thread in order to allow adjustment of the air-gap, and the laminations carrying the conductors are located at E. Instead of poles or teeth the disk C is provided with slots which are milled through the thin rim so as to leave spokes of steel between the slots. The slots are filled with a non-magnetic material which is rivetted solidly in place in order to stand the centrifugal force and to provide a smooth surface on the disk so as to reduce air friction.

Mr. Alexanderson points out that although the present phase of the wireless art refers almost exclusively to telegraphy conducted by the spark method using 500 cycle generators, there are many reasons which lead to the belief that this type of wireless outfit will in the near future be superseded by the system in which a continuous train of waves is used generated by high frequency alternators.

Yarmouth Light & Power Co.

The Yarmouth Light and Power Company, Limited, was recently incorporated taking over the Yarmouth Electric Co. and the Yarmouth Street Railway Co. Since re-organization this company have relaid two miles of old track and put down a quarter mile of new, with 60 pound rails and tamarac ties, extending the line southward over Church Hill and tapping a fairly thickly settled section of the town. They have strung one and a half miles of new trolley wire and renewed the poles along the line, and with the addition of three new cars, have a thoroughly efficient and up-to-date service, operating two and a quarter miles in the winter and nearly three and a half miles in the summer when the park at Lakeside is opened.

A contract has been entered into with the town, whereby for the term of ten years, this company will light the streets, operate the fire alarm system and pump the water, at an annual charge of $8,500. To light the streets under the terms of the contract it has been necessary to erect many poles, arrange new circuits and install lights. This work is under way and will be completed in a few weeks. The prospect for furnishing power to industrial and other plants is very encouraging at present, and several contracts have been entered into, while others are in process of negotiation.

The hydraulic power plant at Carleton, capable of supplying 500 h.p., and the installation of new generating equipment in connection with the auxiliary steam plant in town, which will give the latter a capacity of 450 h.p., indicates the company is well equipped to meet all present needs, and reasonable future expansions. A 22,000 volt, 3 phase, transmission line 18 miles long connects the hydraulic plant at Carleton with the sub-station in town.

The directors of the Yarmouth Light and Power Company are: Willard M. Kelley, president; Edgar K. Spinney, vice-president; John T. Murphy, W. H. Covert, Blake G. Burrill, and C. C. Richards. Mr. John T. Murphy of Halifax, is managing director. Mr. James Graham, formerly of the Canadian General Electric Company at Halifax, is resident manager and general superintendent.

Two-Speed A.C. Motor for Fan Drive

The Westinghouse company have recently brought out a two-speed a.c. motor specially designed for operating ventilating fans in mines. Under average circumstances the number of miners at work during the night is considerably less than during the day time, resulting in a smaller fresh air requirement. The type of machine being used in this particular case is a squirrel cage induction motor with a rating of 7½ horse power at 600 r.p.m. and 15 horse power at 1,200 r.p.m. The change in speed is accomplished by changing the number of poles. The stator of the motor is provided with two windings, one of which gives 6 poles resulting in a speed of 1,200 r.p.m., and the other gives 12 poles with a speed of 600 r.p.m. The connections are changed from one side of the windings to the other by the controller.

Tests made on the operation of this motor by the electrical engineer of the company for which it has been installed, show that this equipment has a practically constant efficiency under both these circumstances. The fan is 5 ft. 6 in. wide with a blade depth of 3 ft. 6 in. When running at 120 r.p.m. with an air pressure difference of .87 oz. per sq. in., 46,200 cu. ft. of air per minute were delivered, and the motor took 9.6 kilowatts, giving an efficiency of 63.03 per cent. for the outfit. When running at half speed or 60 r.p.m., with .29 oz. pressure difference per square inch, 14,850 cu. ft. per minute were delivered and an efficiency of 58.33 per cent was obtained.

Resuscitation from Electric Shock

The subject of "Resuscitation" is so important that at the risk of repeating ourselves we publish below some extracts from a recent address by Dr. C. A. Lauffer, Westinghouse medical director. Dr. Lauffer advocates the Schaeffer method which is at the same time both simple and effective.

A working knowledge of a good method of artificial respiration is essential in every walk of life, and no man can predict whether or not his failure to learn some method may any day be responsible for loss of life. The essential features of the Schaeffer method are (1) the Position of the patient, (2) Posture of the operator; (3) The mode of operation, (4) Rate per minute and duration of operation.

The Position of the Patient

The man is laid upon his stomach, face turned to one side, so that the mouth and nose do not touch the ground. The subject's arms are extended above his head. This position causes the tongue to fall forward of its own weight and so prevents its falling back into the air passage. This fact makes it possible for one man, alone and unassisted, to save the life of a comrade in electric shock or other conditions requiring artificial respiration. Turning the head to one side also prevents the head coming in contact with water or mud during the operation; there is no time for removal of the body to another place, the resuscitation must be begun the instant the body is recovered from the circuit, even though other places in the neighborhood may be cleaner. This position of the subject, further, facilitates the removal of any foreign body from the mouth—tobacco, chewing gum, false teeth, &c., and favors the removal of mucus, blood, vomitus, serum—any liquid that may be in the mouth, or obstructing the air passages.

Posture of the Operator

The operator kneels, straddling the patient's thighs, or kneels by either side of the thighs, facing the patient's head. The operator feels with both hands the bony landmarks of the patient, the prominent bones of the pelvis, the muscles of the small of the back, and the floating ribs. With the lowest ribs located, the operator places his spread hands, with thumb nearly parallel to fingers, so that the little finger curls over the end of the twelfth rib, and the heel of the hand rests near the ends of the lowest ribs; the hands are well removed from the spine, and the fingers are nearly out of sight. This affords maximum leverage on the floating ribs, and correspondingly reduces the muscular exertion required on the part of the operator.

The Mode of Operation

The operator's arms are held straight, and his weight is brought from his shoulders by bringing his body and shoulders forward. This weight is gradually increased until at the end of the three seconds of vertical pressure upon the lower ribs of the patient, the force is felt to be heavy enough to compress the parts; then the weight is suddenly removed. The hands may be entirely removed, or, if there is danger of not returning them to the right position again, merely the pressure may be entirely remitted. Shirt and other clothing should be town off, and the operator's hands should be on the bare back of the patient.

Rate per Minute, and Duration of Operation

The natural rate of breathing is twelve to fifteen times per minute; the rate of operation should not exceed this. The lungs must be thoroughly emptied by three seconds of pressure, then their refilling takes care of itself. Pressure and release of pressure—one complete respiration—occupies about five seconds. If the operator is alone, he can be guided in each act by his own deep respiration, or by counting, or

by his watch lying by his side. If comrades are present, he can be advised by them.

The duration of the efforts at artificial respiration should ordinarily exceed an hour; indefinitely longer if there are any evidences of returning animation by way of breathing, speaking, or movements. There are liable to be evidences of life within twenty-five minutes in patients who will recover from electric shock, but where there is doubt, the victim should have the benefit of the doubt. In drowning especially, recoveries are on record after two hours or more of unconsciousness; hence, this method, being easy of operation, is more liable to be persisted in. The physician on his arrival can determine if there is any heart action. The pulse at the wrist may stop, and the heart still be beating,—a condition calling for continuous rythmic efforts at resuscitation, combined with medication.

Auto-Synchronous Motors

The use of the synchronous motor for industrial purposes is rapidly increasing. This is due chiefly to the necessity of improving the power-factor on large alternating current systems where the load is made up to a great extent of induction motors of various sizes, a great many of which are not usually loaded to full capacity.

The ordinary synchronous motor, however, has several disadvantages, one of which is that it is necessary to have some method of bringing the rotor up to speed before it can be thrown on the line to carry its full load. This must be accomplished either by a separate starting motor or by a short-circuited winding arranged around the periphery of the revolving field, the latter method being usually adopted in America. Both these methods however, have the great disadvantage that they only permit of the motor being started on a small percentage of the normal full load. The synchronous motor has the further disadvantage that if it is subjected suddenly to a severe over-load, or if the voltage drops suddenly due to a disturbance on the line, the rotor will drop out of phase and stop dead and a delay of five or ten minutes will be caused before the motor can be started up again. This, in a great many cases may cause a serious inconvenience to the user.

A type of synchronous machine that has been named the auto-synchronous motor was designed and patented some years ago by the Swedish General Electric Company with the object of combining the advantages of the induction motor with those of the synchronous motor and at the same time of eliminating the objections referred to above. The design of the machine is similar in practically every respect to that of the ordinary slip-ring type induction motor with the exception that a specially designed three-phase rotor winding is used. This, on account of its low resistance, is suitable for connection to a low voltage field current. A specially designed low voltage exciter is necessary on account of the low resistance of the rotor circuit. This exciter is usually direct-connected to the motor shaft and often is series wound as this construction eliminates the use of a field rheostat, the exciter voltage being varied by means of moving the brushes. The exciter voltage varies from fifteen to thirty volts depending on the design of the motors. Machines of this type are manufactured in all sizes up to 1500 h.p. On account of the heavy field current that would be required for excitation due to the low voltage used, this type of motor has not been manufactured in any larger capacities.

Method of Operation

The motor is started up as an ordinary slip-ring type induction motor; that is, by closing the primary switch which leads the three phase current from the line into the stator, (a resistance being inserted in the rotor circuit), and by gradually cutting out resistance in the rotor circuit until on the last contact of the starting resistance the rotor will be short circuited and the motor will be operating as near synchronism as possible. In this way the motor can be started up with as much as twice the full load torque. When the motor has obtained full speed, the starter is cut out of circuit by means of a three-pole double-throw switch, and at the same time direct current from the exciter is fed into the rotor. In the accompanying figure it will be seen that the motor under starting conditions is similar, in theory, to an ordinary three phase transformer with a high resistance inserted in the secondary, A, B, & C being the three phases of the secondary winding. As the resistance is being gradually cut out the current in this winding will increase in value until at the last contact point all resistance is cut out and direct current from the exciter is simultaneously fed into the secondaries, two of which are now automatically connected in parallel so that the current will enter the rotor by (say) the wire A, and leave it by both the wires B & C. The windings A, B & C are so adjusted that the resistance of B & C combined exactly equals that of A. As direct

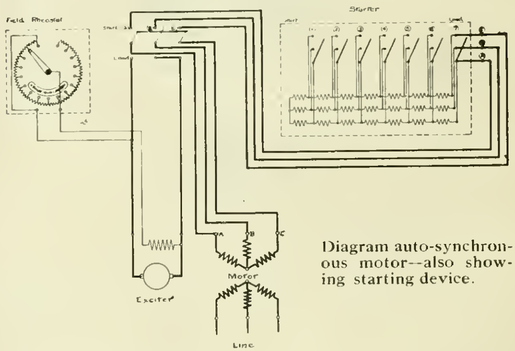


Diagram auto-synchronous motor--also showing starting device.

current is introduced into the rotor the motor will drop into synchronism and operate as an ordinary synchronous motor. The exciting current can then be adjusted to obtain any desired power-factor correction until the full capacity of the motor is being utilized.

Supposing now that a heavy short circuit on the line causes a considerable drop in voltage the motor will then drop out of synchronism, but instead of stopping dead as the ordinary synchronous motor would do, the motor will simply operate as an induction motor, the rotor current being short circuited through the exciter. When the line voltage returns to the normal condition, the motor will again drop into synchronism automatically.

This type of machine has met with considerable favor at different points in Canada, installations having been made as follows,—for the corporation at Preston, Ont., a 50 h.p. unit for driving centrifugal pumps; for the Toronto hydro-electric system, one 450 h.p. unit with direct-connected exciter coupled to a 300 kw. generator; for the city of Calgary, one 1500 h.p. unit with direct-connected exciter coupled to a 1000 kw. generator; for the Ontario Pulp & Paper Co., two 250 h.p. units with direct-connected exciters for pulp grinding. At the present time an installation is being put into the Ontario parliament buildings consisting of two 200 h.p. motors with direct connected exciter coupled to d.c. generators. These machines have all been supplied and installed by Messrs. Kilmer, Pullen & Burnham.

The Electrical News is published semi-monthly. Advise us if it does not reach you regularly.

City and W. E. R. Use Same Poles

Some months ago the city of Winnipeg and the Winnipeg Electric Railway Co. opened negotiations looking to the joint ownership and use of poles for the electric distribution system. The matter of agreement terms was at that time referred to Messrs. R. S. Kelsch (for the company) and J. M. Robertson (for the city), points of disagreement to be referred to the Public Utility Commission. On these latter points Commissioner Robson has now handed down his judgment, finally concluding the terms on which the two interests become equal owners of a single system of poles for the distribution of the energy of both.

While this is not the first case of joint use of poles in Canada, the idea having been successfully tried out at different points, it is the first case of such an arrangement between two systems in direct competition with one another in supplying the same kind of service. The following extracts from Commissioner Robson's report will be of interest.

"The arrangement that has been defined for a system of jointly used poles for electrical distribution by the power and light department of the city and the street railway company is a very important and novel reform. The benefits to be gained are very important. Economy is a conspicuous feature. The saving of interference of separate poles and wires in the same line will remove serious danger possibilities and the conflict which thereby ensues between the two interests. The improvement of street appearance is apparent, and is itself worth the effort.

"The serious problem arose in the cases, very general in the city, where there now exist double lines of poles and wires on the same side of a street. The company being in possession under a franchise, and being first in occupation, naturally occupied a dominant position, and had rights which the city's representatives fully recognized. The company was under no obligation to move its line or in any way abandon its position, but was willing to enter the arrangement on equitable terms. These terms have been defined in the new arrangement. The city's poles being newer and higher, are to be always used where possible, and the company's wires are to be placed thereon. The company's investment in its pole system being thus virtually extinguished, the city is to pay the cost of labor of removing the company's lines to the city's poles, and fair cost of reasonable material without improving the standard of the company's system at the expense of the city. To save involved calculation of the cost and remaining life each individual pole erected by the company (including the cost of erection) it is provided that the company shall take the abandoned poles, removing them at its own expense. Assuming the remaining life of the company's poles as erected to be ten years, the company is at the end of that time to pay to the city one-half of the then value of the city's poles to which the company shall remove its lines, and is to pay the amount it would then cost the company to affix its wires. Those experienced in such matters express the view that twenty-five years is, in this country, the average life of a pole. On these terms and within such time as the magnitude of the work and expense permit, the lines will be transferred to the city poles, and the company poles removed. Provision has been made that where only one line of poles at present exists, the other party may use it as a joint line on suitable terms. Where there is no duplication of line on the same side as in cases where the company's system occupies a different side of a street from the city's, or the city's is in the lane, the company may remove to the city's line on the same terms of compensation to the company for its cost of abandoning its line and making the change. Such a removal may be ordered in special cases by the commission. Provision is made for increasing accommodation where a pole line become inadequate for all lines of both interests. The Street Railway system is not to be affected, but where power and light poles or street lighting standards are available to sustain span wires that may be done on proper terms. Various details are considered, and a complete set of specifications is declared. Valuing and accounting provisions and methods of operating and regulation of work form important features. It is to be hoped that by earnest and harmonious co-operation the terms so reached may be of benefit to the two concerns in economy and facility of operation and tend to the improvement of electrical distribution in the city and the appearance of the streets, besides greatly reducing the obstruction to firemen in the performance of their duties.

"Underground construction being of a very special and expensive nature is left to be dealt with independently. This may be accomplished under the terms of present legislation which provides for conduit construction by the city in congested districts, and for the renting of space to the company, or the company may proceed towards construction of its own conduits. The subject may also be dealt with independently under the Public Utilities act. Joint operation is feasible, but to devise adequate measures a long time will be necessary. It requires special consideration and cannot be made the subject of rules of a general character. Steps should be taken very soon with a view to placing electrical distribution in the down town section underground. There is at present too much overhead distribution. Where danger is imminent the matter should have immediate attention. There is also a large territory where this reform, while not at once urgent, is highly desirable. The matter of expense is in that stage a proper consideration. It might mean an additional and unproductive capital expenditure of very large amount. In some cities the conduit system is made a municipal project, each utility renting space. The subject has varied phases which will require careful thought on the part of those in charge, for both the city and the company."

Development on Magpie River

The Algoma Steel Corporation of Sault Ste. Marie has practically completed an installation on the Magpie river at Steep Hill Falls, power from which will be transmitted to the Helen mine five miles distant, and the Magpie mine twelve miles distant. The dam is of the Ambursen type, and is now completed. It is built of reinforced concrete with buttresses spaced twelve feet apart supporting deck slabs tapering in thickness from 30 in. at the bottom to 17 in. at the top. The height of the spillway above the river bed is 45 ft. and the total length of the spillway is 145 ft. The overall length of the dam is 230 ft. The dam is so constructed as to allow of the height being raised another 12 ft. It is interesting to note that much of the concrete of this dam was placed when the thermometer registered as low as 60 deg. below zero. The water, sand and rock were steam heated and the concrete was covered with canvas, and every possible means taken to keep it above freezing point. It is reported that the concrete put in in this way was generally satisfactory.

The total head available at this point is about 60 ft. Two turbines of the William Hamilton Co. type, Peterborough, are being installed, each with a capacity of 1000 h.p. These will be direct-connected to three-phase generators of the Crocker-Wheeler type designed to develop 900 kv.a. at 11,000 volts and 400 r.p.m. The exciter is driven by a Rodney-Hunt turbine. The switchboard is Ferranti type and

provides, through a simple system of levers, for the hand operation of the oil-type switches on the generators and feeders.

Water is led to the turbines through a steel penstock 240 ft. long and 8 ft in diameter constructed of ¼ in. to ⅜ in. steel plates. At the power house the pipe divides into two 6 ft. branches. These are connected to a 12 ft. diameter surge tank having a total height of 80 ft. The surge tank is constructed of rivetted steel plates 7/16 in. to ¼ in. thickness. The intake is closed by racks consisting of bars ¼ in. thick, spaced 1 9/16 in. apart.

Two three-phase circuits leave the generating station, being carried on one set of poles for a distance of 1½ miles to an open air switching station, which allows of various connections being made to facilitate fault location and permits of repairs being carried out without the necessity of disconnecting the supply from both mines. From this point one line leads to the Helen mine the other to the Magpie. Three-phase current is used almost entirely at the Helen mine, being used for the main hoisting engine and the various motors driving crusher, air compressor, conveyors, pumps, etc., both on the surface and below ground. At the Magpie mine a portion of the three-phase current, after reduction to 600 volts, is used for driving a motor-generator to provide continuous current for the motors utilized for varied purposes including the ore bridge, a large travelling bridge for the handling of the ore.

On account of the strong winds that are not infrequent in this district, and are sometimes combined with low temperatures and sleet storms, which may lead to ice deposits on the wires, the line has been very strongly built from the mechanical standpoint—the poles being spaced about 130 feet apart, while double poles of the H type are provided at the ends of extra long spans. This construction is used on spans up to 480 feet. There are two spans of approximately 1000 feet on the comparatively short line to the Helen mine

Steel tower supporting 1,000 ft. span over ravine

These are at points where deep depressions in the ground have to be bridged. Substantial towers are provided at the ends of these spans, and the conductors are dead-ended on strain insulators. Moreover, instead of using the No. 1 size stranded aluminium conductor, as on the remainder of this section of the transmission, a conductor consisting of aluminium wires of equivalent section surrounding a central galvanized steel core wire, is provided, the mechanical strain being taken mainly by the steel core.

As lightning is a frequent cause of trouble during the summer months, lightning rods are provided, on the average, at every fourth pole, and over the section between generating station and open-air switching tower at junction of lines, a grounded galvanized steel cable connects the pole tops. Lightning arresters of Garton-Daniels type are provided at the generating station and at the Magpie mine sub-station, while the Helen mine sub-station is protected by multiple-gap arresters of the Westinghouse type. An at-

Wood tower supporting 1,000 ft. span, Helen Mine

tempt has also been made to relieve the wires of high potential charges before these reach the apparatus in the generating station, by providing a complete set of horn-gap arresters on the switching structure at the junction of the lines. These arresters are provided with resistances between horn-gap and ground in the form of ordinary 45 gallon barrels filled with water through which the discharge must pass.

A telephone circuit connecting the mines and the power station is carried below the h. t. wires on the same set of poles; a complete transposition of the two telephone wires being made at every second pole. There are no transpositions on the h. t. conductors.

The Long Sault Development

In 1907 the New York legislature passed an Act granting certain rights to the Long Sault Development Co., in the vicinity of the Long Sault Rapids on the St. Lawrence river near Cornwall, Ont. This Act gave authority to develop power at that point. The United States Senate however, refused its consent to this Act becoming law and Attorney-General Carmody was requested to submit his views on the constitutionality of the Act. These views have recently been submitted to the Senate and they hold that the powers and privileges granted to the company are in direct violation of certain provisions of the state constitution and that the legislature exceeded its authority in making such grants. He says the law in question is private and local, and grants an exclusive privilege, that the land acquired is within the forest reserve, and that the act is therefore unconstitutional. The report also draws attention to the marked disparity existing between the value of the rights granted the company and the small remuneration received by the government therefor.

Rotary Converters at C.P.R. Docks

The following installation of two 600 kw. Westinghouse rotary converters with necessary equipment of transformers, equalizing generator, etc., was made during the past summer for use by the Canadian Pacific Railway Company at their new coal handling docks in Fort William.

Power is received at 25,000 volts from a 3-phase, 60 cycle line (Kaministiquia Power Company) and transformed through two sets of three 200 kw. single-phase transformers, oil-insulated, water-cooled, 60 cycle, star-connected primary 14,500 volts, delta-connected secondary 178 volts.

At the latter voltage power is delivered to the two 600 kw. 6-phase rotary converters shown in illustration No. 1. These machines give 250/280 volt d.c. 2400 amp. at 600 r.p.m., and are connected in parallel to the d.c. bus-bars.

As the load is a rapidly fluctuating one, special provision had to be made to handle the peak loads. This has been very successfully taken care of by the use of a fly-wheel, direct-connected to a d.c. machine which alternately operates as a generator or motor across the d.c. bus-bars. This is,

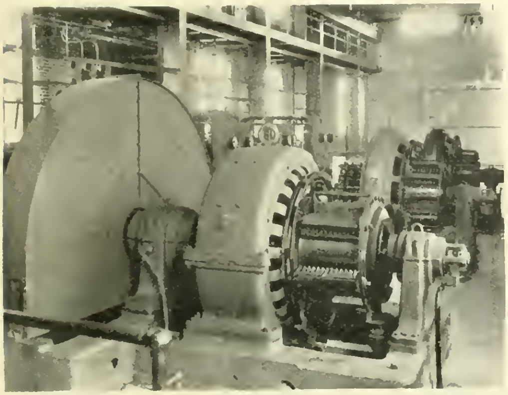


Fig. 1—Two 600 kw., 6 phase, rotary converters, Fort William

perhaps, the first application of this system to the unloading of coal.

The d.c. equalizing machine is rated at 400 kw., 250 volts; is compound-wound and is capable of handling heavy overloads for short periods. The direct-connected fly-wheel weighs 15 tons made up of solid steel plates which gives a high factor of safety. The wheel is enclosed in a heavy steel plate cover. This machine has a speed variation of from 450 to 600 r.p.m. depending on what load is being taken from the d.c. bus-bars.

On light load the set automatically speeds up, taking power from the line, but with a heavy load on the line the speed tends to fall off and the generator feeds back on the line, taking power from the fly-wheel. This speed variation is obtained by changing the shunt field resistance through a water rheostat, which is operated by the special torque motor shown in the lower part of illustration No. 2.

Lightning protection is afforded by air-cooled choke coils and a three-phase type "A" electrolytic lightning arrester designed in this case for use on a 25,000 volt line. The arrester tanks are mounted in the gallery. The arrangement of the high tension bus-bar system is very open. The bus-bars are connected to the incoming line and to the transformers through type "E" 35,000 volt, three-pole, hand-operated, automatic oil circuit breakers shown in illustration No. 3.

Besides the transformers supplying power to the converters there are two 3-phase transformers for a.c. power purposes. They are rated at 100 kw. and transform from 25,000 volt primary to 2200 volt secondary.

Fig. 2—A.c and d.c. switchboards, special torque motor in foreground

The switchboards are of black marine finished slate mounted on angle iron frames. A total of 17 panels has been installed. The control panel for the incoming line is located immediately in front of the transformers, while on either side of it are the panels controlling the a.c. side of the rotary converters.

At the left of illustration No. 2 is shown the d.c. control board, while the board at the right controls the 3 phase transformers.

Mr. R. S. Kelsch was consulting engineer and the equipment was manufactured by the Canadian Westinghouse Company at their Hamilton works.

Fig. 3—3-pole, hand operated, automatic oil circuit-breakers

The Berlin, Ont., Electrical Department receipts to date have been $74,538; expenditure $49,369, leaving gross profit $25,169. After deducting debenture installments this leaves a net profit of $19,631.

Montreal and Eastern Canada

After a strenuous fight, the Quebec Legislature has granted the Montreal Tramways Company an exclusive franchise for 25 years for the town of Mount Royal, which is the new name of the model city to be founded by the C. N. R. in connection with their tunnel scheme in Montreal. The Public Service Corporation, which is closely associated with the Montreal Tramways Company, secured a 15 years' franchise for the supply of light and power, a clause being inserted which allows the Montreal Light, Heat and Power Company to sell light and power to private individuals. The Tramways company have also an exclusive franchise for the neighboring parish of St. Laurent, and the Public Service Corporation a franchise for light and power, the rights of the Montreal Light, Heat and Power Company in the latter case being safeguarded. The Public Service Corporation has authority to charge ten dollars per annum for the 16 candle power incandescent lamps and varying rates, from $90 per annum to $75 per annum per 1200 candle power arc lamp, according to quantity installed; for private lighting, ten cents per kilowatt hour, with a discount of 10 per cent on yearly contracts and a discount of 25 per cent. on five year contracts. Consumers of power must guarantee a minimum of $20 horse power per annum from one to twenty horse power, and of $15 per horse power for each additional horse power, the motor to be of a type acceptable to the company.

Quebec

The Quebec Streams Commission is a body which has been invested with the powers of a corporation in order that it may carry out a scheme of constructing a huge storage reservoir on the upper St. Maurice for the purpose of regulating the flow of that river for the generation of electricity. The Hon. S. N. Parent, chairman of this Commission, is reported to have stated that work on this dam will be commenced as early as possible and will be completed in from two to three years. It is said that the area of the proposed reservoir will be more than 300 square miles, that the amount of water to be stored will be approximately 160,000,000,000 cubic feet, and that the drainage basin will have an area of more than 16,000 square miles. It is further calculated that under these conditions a regular flow of 18,000 cubic feet will be obtained which will have an immense value for power purposes.

Amateur Wireless

Amateur operators of wireless have been some inconvenience to the Marconi Company, particularly in such large centres as Montreal and Toronto. According to Mr. J. H. Lauer, manager of the company, the proposed legislation by Mr. Hazen on radio-telegraphy will be of benefit to the company especially in the direction of controlling these private wireless stations, which interrupt commercial operations. The rigorous enforcement of the clause in the bill, imposing penalties on unlicensed amateur stations will have the desired effect of weeding out undesirable interference with, and obstruction of, legitimate messages. Most of the regulations in the Bill concerning wireless telegraphy are already in force, and the proposed legislation simply gives public recognition to the regulations.

Telephone Despatching

Four gangs of men are at work on the Grand Trunk main line between Montreal and Chicago installing a telephone system of train despatching. These men are working Toronto to Mosborough, 53.4 miles, and from Stratford to Sarnia, 81.3 miles. There remain therefore only the gaps between Lyn and Belleville, Port Hope and Toronto and Mosborough and Stratford to hinder direct telephonic communication between Sarnia and Montreal, a distance of 506.6 miles. As the completed sections mentioned above total 314.6 miles, and the gangs can average about 35 miles a week, under favorable conditions another five weeks should see the stringing of the last mile into Sarnia.

"Cedars" New Bond Issue

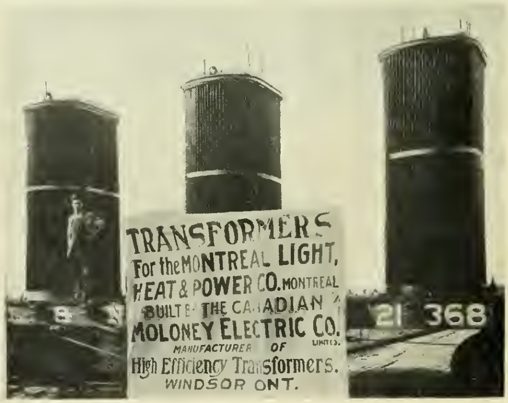
At a special meeting of the Cedars Rapids Manufacturing and Power Company, held in Montreal, on January 3, it was decided to retire the present $10,000,000 bonds, and to replace them with an issue of $15,000,000 forty year 5 per cent. first mortgage gold bonds, to be issued from time to time as required for the development of the property. Mr. J. E. Aldred, president of the company, left Montreal on the night of January 3 for New York, and it was stated would shortly leave for England.

Action for Libel

As a result of trenchant attacks on the Montreal Tramways Company—its service and financing—by the "Montreal Herald," the directors have taken action for libel, claiming $650,000 damages. The plaintiffs are Messrs. E. A. Robert, president of the company; F. H. Wilson, director; J. W. McConnell, director; J. M. Wilson, director; W. C. Finley, director; J. M. McIntyre, director. Exception is particularly taken to one article relating to the disposal of an issue of $10,000,000 capital, which the plaintiffs regard as a very serious imputation on their reputations as honorable men.

Large Transformers

The cut shown herewith represents three transformers recently supplied to the Montreal Light, Heat & Power Company, by the Canadian Moloney Electric Company, of Windsor, Ont. These transformers are oil-insulated and water-



cooled. The capacity is 750 kv.a., 12,600 volts, 60 cycles. They are installed in the main sub-station of the Montreal company.

The Stuart-Howland Co., electrical supplies and specialties, Boston, announced their removal to 131-141 Federal street, beginning with the new year. This is the third time this company has removed since starting in business twelve years ago and for the same reason in each case, viz., that their business has outgrown the previous quarters. In each case they have nearly or quite doubled their floor area. Their new offices, store and wareroom will now give them ample room for handling their increasing business.

Miscellaneous

A petition has been presented in the Superior Court, Montreal, for the winding up of the Montreal Merchants' Telephone Company. The company has been in business for several years, and has about 1500 subscribers, all in the Montreal district. The petition stated that the sum of $220,000 is due to Mr. R. P. Lydon, of New York, that the company has no available means of meeting this debt, and that the directors decided on December 20 last to voluntarily wind up the company.

It is officially announced that the C. P. R. propose to extend their telegraphic facilities in Saskatchewan; the programme will include additional wires between Moose Jaw and Calgary, and Moose Jaw and Winnipeg. The facilities in northern and northwestern Saskatchewan will be increased nearly 100 per cent. The wires now working between Moose Jaw and Winnipeg will be added to.

For some time there have been persistent reports that the Bell Telephone Company is to be reorganized, and the latest rumor is that the plan involves the subsidiary companies—the Northern Electric and Manufacturing Company and the Imperial Wire and Cable Company—whose shares would be distributed proportionately to the shareholders of the Bell Telephone Company.

Mr. W. G. Ross, formerly managing director of the Montreal Street Railway Co., has been appointed chairman of the Montreal Harbor Commission, and has taken up his duties. Mr. Ross's appointment has been received with universal approval. He resigned his position with the street railway company shortly after Mr. E. A. Robert secured control.

Mr. A. B. Smith has been appointed manager of telegraphs of the Grand Trunk Railway, with headquarters at Montreal. Mr. Smith has hitherto held the same position on the Grand Trunk Pacific, with headquarters at Winnipeg, so that his jurisdiction has been very widely extended.

The National Hydro-electric Bill has been slightly amended by the Quebec Upper House. It is now agreed that in the event of the company and any municipality failing to agree as to a franchise, the Quebec Public Utilities Commission will intervene and arrange the conditions.

Mr. J. Stanley Hyman, of the Northern Electric and Manufacturing Company, died in the Western Hospital, Montreal, on Jan. 5. He had just returned from a business visit to the Maritime Provinces for his company. Mr. Hyman was 24 years of age.

Pringle Limited, incorporated with a capital stock of $20,000, to carry on business as electrical and mechanical engineers, with head office at Montreal.

The Bayliss Pulp and Paper Company, of Quebec, Que., has contracted with the Stadacona Hydraulic Company for 6,000 horse power.

New Companies

Federal Engineering Company Limited, has been incorporated with a capital of $500,000, to carry on business as manufacturers and dealers in electrical machinery, appliances, plants, etc., with head office at Toronto.

Personal

Mr. R. E. T. Pringle has resigned his position as managing director of the Canadian Moloney Electric Co., Ltd.

Mr. R. A. Ross, consulting engineer, Montreal, has been engaged by the city of Calgary to make a report on the local light and power situation.

Mr. R. T. Jeffery, for some years associated with the electrical department of Smith, Kerry & Chace, has resigned to engage in general engineering work with the Hydro-electric Power Commission of Ontario in connection with their extensive work among the various municipalities.

Mr. F. John Bell has resigned as general manager of the British Canadian Power Company, Cobalt, as the outcome of the amalgamation with the Northern Ontario Light & Power Company. He has been appointed general manager of the Canada Wire & Cable Company, Toronto.

Mr. F. J. Goodman, who has been representing the Century Telephone Construction Company in Canada, will take up his work in the United States for the same company. Mr. Goodman's place in the Canadian field is being taken by Mr. W. C. Freeman, formerly with the Stromberg Carlson Telephone Company.

Mr. L. V. Webber, chief of the meter department of the Toronto Electric Light Co., has resigned his position to become sales manager for the Metropolitan Engineering Co. Mr. Webber's long experience with the T. E. L. Co., and his very thorough knowledge of meters fit him especially for the important work he is now undertaking.

Mr. J. A. Ellis, M.L.A., city treasurer and nominal head of the Ottawa Municipal Electric Department, was elected mayor of Ottawa for 1913 on Monday January 6th, by a substantial majority over two other candidates. Mr. Ellis, who has been secretary of the municipal electric department, will still hold that position, but will not accept salary while he holds office as mayor.

Mr. Jas. Anderson, manager, the Sandwich, Windsor & Amherstburg Railway Company, sails for Europe on January 21st, via the White Star line steamer Cedric. Mr. Anderson will travel by way of the Mediterranean and thence north through various points of interest, and will be absent about three months. Mr. A. M. Stewart, ticket agent of the Grand Trunk railway system of Windsor, will accompany Mr. Anderson.

Mr. J. D. Evans, chief engineer of the Montreal Tramways Company, has resigned to become construction manager of the Electric Bond and Share Company, of New York. Mr. Evans is a graduate of the Massachusetts Institute of Technology. He has been at different times in the employ of the U. S. Government in connection with the Panama Canal work, and of the Republic of Ecuador in steam railway construction, and later has been engaged in electrical work for the Great Northern Power Company, the Canadian Light and Power Company and other large private corporations, before associating himself with the Montreal Tramways Co.

The Canadian British Engineering Company

Announcement is made by The Canadian British Engineering Company of the purchase of the stock-in-trade of the James Stuart Electric Company, of Winnipeg, with the intention of carrying on this well-known wholesale electric supply business at the old address, 324 Smith street. The warehouse and showroom of this company will have a combined floor space of over 15,000 square feet, which will enable them to carry a large variety of stock.

Prairie Province Activities

Port Arthur, Ont.

Activity in Port Arthur is shown by the number of by-laws recently submitted which approximate three-quarters of a million dollars. This sum includes an expenditure of $12,000 for a motor-generator, $6,550 for extending the municipal railway system, $32,400 for the re-laying of tracks with heavier steel, $35,000 for extensions and improvements to the telephone system, $6,500 for completing the service dam on Current River in connection with the city's power developing scheme, $8,000 to extend the street lighting system and $30,000 to extend and improve the electric lighting system.

The following figures, showing the estimated cost of constructing single track, in pavement, on Algoma street from Arthur to Cameron streets are of interest. This includes paving that portion of the street between the rails and for a distance of eighteen inches on each side of the rails.

Rails	$ 823.00
Rails, hauling	40.00
Ties	168.00
Spikes	27.00
Angle Bars	26.40
Bolts	6.25
Bonds	8.80
Bonding	17.60
Earth excavation	165.10
Track laying	228.60
Earth overhaul	38.10
Extra concrete	1,315.31
Paving	2,131.29
	$4,995.45
Overhead work	600.00
Supervision and contingencies	555.55
	$6,151.00
Interest six months at 5c	307.55
	$6,458.55
Advertising	91.45
Total	$6,550.00

Edmonton's Proposed Belt Line System

The city of Edmonton has drawn up a comprehensive plan of street railway extension work designed, at the same time, to economically meet the needs of the present population and also to be capable of almost unlimited expansion to keep pace with the city's prospective growth of the next decade.

The system mentioned is comprised of 15 routes, all of which are belt lines, and which are so arranged that at no point inside the district covered will an intending passenger have to walk more than two or three blocks to reach the car. Based on a 15-minute headway each way on individual routes, the number of cars passing various points in the city will vary from eight cars per hour to seventy-two, the latter, of course, being in the more congested business district.

The total length of track required for this lay-out is approximately 110 miles, and it is estimated that 220 cars will be sufficient to maintain the regular schedule.

The railway department proposes to make all future extensions of track with a view to ultimately attaining this lay-out. The length of time taken for this will, of course, depend upon the rate of growth of the city.

The system has been so designed that, should unforeseen circumstances require it, any of these routes may be shifted a block or two in either direction without disarranging the main plans.

Minnedosa, Man.

An electrical plant is being installed in Minnedosa at the present time which it is expected will be in operation in the course of six weeks or two months. One generator only is at present being installed consisting of a 312½ kv.a., 60 cycle, 3-phase, 2400 volt, horizontal unit running at 257 r.p.m. The exciter is a 20 kw., 125 volt, 600 r.p.m. The switchboard consists of two panels, one for exciter and one for the a.c. generator, the generator panel having an a.c. ammeter on each phase, high tension volt meter, exciter ammeter, and time relay. The exciter panel at present carries only an ammeter and a d.c. volt meter. The exciter is a compound-wound interpole machine sufficiently large to supply the exciting current to a duplicate alternator, when the plant is extended, the power house being laid out for such an extension. The exciter is driven by an independent turbine.

All the electrical installations are being supplied by Messrs. Kilmer, Pullen and Burnham, Canadian agents for the Swedish General Electric Co. The turbines were manufactured by Wm. Kennedy & Sons, Owen Sound, Ont., and are designed to operate under an effective head of 25 feet. In addition to the regular fore-bay supply of water, there is also a reserve supply obtained by means of damming a lake some thirty-five miles north of Minnedosa. C. H. and P. H. Mitchell are consulting engineers for the municipality.

Dauphin, Man.

Contract has been awarded to E. Leonard & Sons, of London, Ont., for two horizontal return tubular boilers and one tandem compound engine. The Canadian General Electric Company is supplying a 125 kw. generator. The latter company also have the contract for the supply and erection of a distribution system, including forty series tungsten street lights and thirty-five ornamental standards. Bids will be received and contract awarded for brick power house at an early date.

Mr. R. A. Ross, of Montreal, has been engaged by the city of Calgary to report on the local power and light situation.

New Publications

The practical Electrician's Pocket-book and Diary, 1913; 1s net; S. Rentall & Co., Ltd., 36 Maiden Lane, Strand, W. C. London, Eng., publishers; edited by H. T. Crewe, M.I. Mech. E. The contents of this book are chiefly compiled for readers who are for the most part practically engaged in one or other of the many branches of trade in which electricity now plays an important part. This year's publication is some forty-four pages in excess of the 1912 edition in spite of the fact that certain standard sections have been omitted. The larger size is due to the inclusion of a quantity of new matter which has been brought into more prominent notice during the past year, such as coal cutting machines, electric vacuum cleaners, and control of lighting circuits. The appendix contains useful tables of various kinds, for example, a table showing the size of cable to be used on circuits carrying various currents at different voltages. This book can be safely recommended as reliable, and certain to prove of real value to the practical man.

New Equipment for Nanaimo

The rapid growth of the city of Nanaimo has called for a large increase in the amount of current used for lighting and heating purposes, and the Nanaimo Electric Company have found difficulty in meeting the ever increasing demand although they have made several additions to their plant within the last two years. At the commencement of this year they found that their present service would be severely overloaded during the present winter and this article will deal with the provisions they have been making to meet their calls for power.

Their plant up to the present has consisted of a substantial brick building containing the following equipment:— A set of three Pelton water wheels capable of developing 500 h.p. and for emergency and overload service they have one 16½ in. x 24 in. side-crank piston valve engine. This engine is supplied with steam from two return tubular boilers working at a pressure of 120 lbs. The water wheels are belted to a line shaft from which are driven one 25 kw., d.c. arc machine, one 50 kw., d.c. arc machine, one 150 kw., 3 phase, 2300 volt revolving field alternator excited by one 5½ kw., d.c. bipolar generator, and one 120 kw., single phase, 1154 volt alternator with direct connected exciter.

As the supply of water available for power purposes was limited, Mr. Joseph Hunter, president of the company and chief engineer for the Canadian Collieries, Ltd., decided that to increase the capacity of their plant it would be necessary to install either a direct connected steam engine driven generator set or a turbine driven set. Owing to the difficulty of obtaining an adequate supply of water for condensing purposes which would permit of their installing a turbo-generator set having reasonable steam economy, it was decided that the only type of apparatus that would be at all economical was a compound high speed engine generating set arranged to run non-condensing for the present but designed so that at some future time condensers might be added.

Acting on advice from Mr. Frank Sawford, chief electrical engineer for the Canadian Collieries and upon Mr. Hunter's suggestions, Mr. William Lewis, general manager for the Nanaimo Electric Light Company, made a contract with Messrs. Taylor and Young, Ltd., mechanical engineers, of Vancouver to supply and erect a 450 B.h.p. compound high speed engine manufactured by Messrs. Jas. Howden & Co., of Glasgow, Scotland, for direct connection to a 300 kw., 2200 volt alternator with direct connected exciter, manufactured by Messrs. Bruce Peebles & Company of Edinburgh, Scotland. This complete unit is to be delivered and erected by the firm who were awarded the contract and as it is the first installation of its kind in British Columbia full particulars concerning it will be of special interest. The following is a fairly complete specification of the unit that has been ordered consisting of one 300 kv.a. direct-connected steam-driven alternating current generating set.

Engine

One "Howden" two crank compound double-acting vertical engine of the enclosed type fitted with their patent improved system of forced lubrication, to develop 450 brake horse-power at 360 revolutions per minute, with a steam pressure of 125 lbs. per square inch at the stop valve when exhausting into atmosphere. The engine is mounted upon a short base, the dynamo being upon its own horse shoe type bed plate and connected up through the shafts.

Frame—The working parts are enclosed in a strong vertical casing accurately machined top and bottom and securely bolted to base. Large doors secured by nuts are provided at both sides giving unrestricted access, and small hinged doors opening with one handle are provided for ready access to facilitate examination. Distance pieces carrying the cylinders are secured to the top of the casing, sufficient height being provided to ensure that the oil is not drawn up from the crank-case to l.p. cylinder when working condensing.

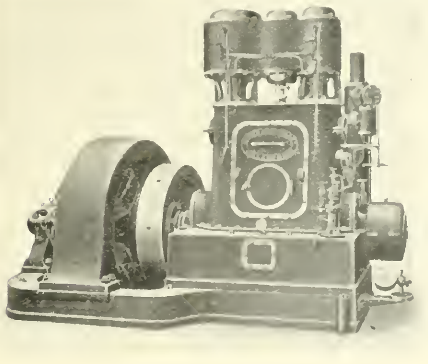
Cylinders and Pistons—The cylinders are of the best hard close grained cast iron in one piece with valve casing between them which is fitted with improved piston type slide valve distributing steam to both cylinders,—external steam piping between cylinders is entirely dispensed with thus avoiding considerable loss from condensation. Both sides of pistons, and insides of cylinder covers are turned and polished. The cylinders are neatly covered with blue planished sheet steel, the cylinder covers and valve chest covers being similarly finished and covered, the space under planished plate being filled with asbestos fibre. The pistons are made in one piece, the low pressure being made of cast steel. Two cast iron packing rings, accurately machined, are fitted to each piston, the arrangement being specially suitable for high pressures and high temperatures.

Packings—Piston rods and valve rods are provided with metallic packings of improved type.

Piston Rods—are of high carbon steel, accurately finished on special grinding machine, and secured by fitted bolts to cast steel crosshead.

Crosshead Pins—are of mild steel, case-hardened and ground after hardening.

Connecting Rods—are unusually long, viz. seven



Type of Equipment being Installed in Nanaimo

times the length of cranks, reducing pressure on guides and connecting to exceptionally smooth running and absence of vibration.

Crank Shaft—is of Siemens Martin steel, with throws cut out of the solid. There are four bearings in the crank case, giving exceptionally large bearing surfaces, all being lined with Richards' anti friction metal. The cranks are placed opposite, thus balancing each other.

Governor—is carried directly on the crank shaft and actuates a double beat throttle valve, controlling the speed to within 2 per cent variation from full load to no load. Momentary variations, full load instantaneously switched off and on, 5 per cent.

Speed Regulating Gear—This is arranged to permit of a 10 per cent variation while the engine is running.

Flywheel—A heavy flywheel machined all over, with polished rim, is fitted, ensuring a minimum momentary variation of speed under a fluctuating load.

Overloads—The engine is fitted with a by-pass valve to enable it to carry 25 per cent. overload for two hours which would be available on the alternator. This by-pass

valve admits high pressure steam into the low pressure cylinder.

Efficiency—The mechanical efficiency of the engine is not less than 92½ per cent. at full load.

Accessories—Sight feed lubricator, steam pressure gauge, oil pressure gauge, cylinder drain cocks and pipes, relief valves, tachometer, set of spanners and tools, barring lever, set of foundation bolts and anchor plates are included.

Alternator

One 300 kv.a., 3 phase, 2200 volt Bruce Peebles alternator mounted on horse shoe type bed plate and connected to engine through coupling.

Capacity—The alternator will be designed for a normal full load capacity of 300 kv.a. at unity power-factor, 2200 volts, 60 cycles, 3 phase when running at a speed of 360 r.p.m.

Temperature Rise — This measured thermometrically after 24 hours' full load run will not exceed 23.9° C. above that of the surrounding atmosphere and 37.8° C. after two hours' run at 25 per cent. overload.

Efficiency—The efficiency of the alternator at the various loads and at unity power-factor will be as follows:—full load 92½ per cent.; ¾ load 91½ per cent.; ½ load 89 per cent.; ¼ load 81 per cent.

Voltage Regulation—The voltage rise when full load is switched off will not exceed 7.5 per cent. assuming constant speed and excitation and unity power-factor.

Exciter—The exciter for this alternator is mounted on an extension of the armature shaft and has an independent outboard pedestal bearing.

One of the noteworthy features of this installation is its low steam consumption under steam conditions which are to say the least not favorable, the consumption of the combined set at full-load not exceeding thirty-two pounds per kw. hour when operating non-condensing.

Messrs. Taylor and Young, whose name has been identified with steam power plant engineering for some time and who recently installed a large special turbine-driven Fire Underwriters' pump for the North Pacific Lumber Company at Barnet, B.C., are to be congratulated on having been instrumental in introducing the first high speed engine of any size into British Columbia.

Telephones and Telegraphy

A public warning has been issued by the Bell Telephone Company against the use of unauthorized mouth pieces and other devices. Mr. R. F. Jones, the Montreal manager of the company, states that these devices are detrimental to efficient service, and that best results are obtained from the regular sets supplied to subscribers, without the use of these so-called "improvements." Under the terms of contracts made with subscribers these attachments are not allowed, and Mr. Jones states that the service would be brought to something approaching a standstill if the company were to allow each subscriber to use any freak attachment that he wished. The company object to rubber sound mufflers, designed to prevent by-standers hearing what is said; "hear plain" patent devices for increasing the volume of the voice; and "handless telephones," the object of which is to do away with the necessity of holding the receiver to the ear. Objection is also made to the many devices which claim to provide sanitary conditions in the mouth-piece, the majority being dependent for their efficiency upon repeated treatment with a form of liquid disinfectant. Dr. Harold Spitta, bacteriologist to the British Royal Household, has made a number of investigations into the question of the transmission of consumption by means of telephone mouth-pieces, and has reported to the British Postmaster-General that such transmission is practically impossible. The telephone companies have also made extensive experiments on the same subject, and the opinion of Dr. Spitta is in harmony with the results of these experiments.

Proper Atmosphere for Telephone Employees

Contracts have just been signed for the installation of apparatus for purifying the air in the switch and toll rooms of the Citizens' Telephone Company of Grand Rapids. The arrangement provides for working in rooms closed practically air-tight. The windows will be double and all crevices and cracks will be tightly caulked and the doors will be closely guarded. The air for about fifty employees will be fanned into these rooms passing through sprays of water so as to be cleaned of all dust or other impurities. This air will then pass over coils which will warm it in winter and cool it in summer. From the coils the air will pass through a dehumidizing machine which will take the moisture out of it or release moisture to it so as to maintain a certain standard. It is guaranteed that this apparatus will produce air that will not vary 5 degrees in temperature or 5 per cent. in humidity.

The Welland County Telephone Co.

This company are now installing at the Ridgeway exchange, a two position, 200 line magneto switchboard of modern design and equipment. The Welland County Telephone Co. have enjoyed a steady and continuous growth since organization some five years ago and now have exchanges in Bridgeburg, Fort Erie, Ridgeway and Stevensville, and are giving service to practically all points in Welland county. They have upwards of 800 telephones on their system and because of the extraordinary demand for their service it has been deemed advisable to install the above larger equipment in Ridgeway. This company are an independent company and connect with the system of the Federal Telephone and Telegraph Co. of Buffalo by means of a submarine cable laid across the Niagara river. This gives them an extensive long distance service.

The Bruce Municipal Telephone Company

Practically all of Bruce County is covered by the lines of the new Bruce Municipal Telephone Company. Exchanges have been installed and are now operating at Port Elgin, Paisley, Underwood, Tiverton and Kincardine, and very nearly 1,000 subscribers are now connected for service. All exchanges are connected by through trunk lines and experiments are now being conducted with phantom circuits for trunking service. When the construction work of this company has been completed, the Bruce municipal company will have the largest system of this kind in eastern Canada.

St. Marys, Kirkton & Exeter Telephone Company

During the winter season many improvements have been made in this company's system. A new switchboard of 150-line capacity has been installed at their Granton exchange. This is to take care of extensive development work which will be undertaken early in the spring. This company is undoubtedly one of the most progressive in western Ontario and a very large share of their phenomenal growth has been due to the efforts of Mr. John Perry, general manager of the company. Their directory now contains between 400 and 500 names and service is being given at St. Marys, Granton, Kirkton, Exeter and the adjacent rural districts.

Advises Automatic for New Zealand

A report has been presented by Mr. Buckley, chief electrician of the post and telegraph department of New Zea-

land, who last year toured America, England and Europe with the object of studying various systems of telegraphy and telephony. He states that an automatic system of telephones would most satisfactorily meet the requirements of New Zealand and would possibly permit of an extension of the area within which a minimum residential rate might be charged. Mr. Buckley computes that a saving of over $10,000 a year might be expected from an automatic system at each of the four cities, namely, Auckland, Christchurch, Dunedin, and Wellington.

New Books

Wireless Telegraphy and Telephony Simply Explained.—by A. P. Morgan. The Norman W. Henley Publishing Company, New York. Price $1.00. This is a practical treatise embracing complete and detailed explanations of the theory and practice of modern radio apparatus and its present day application, together with a chapter on the possibilities of its future development. The author has endeavored to furnish a comprehensive explanation in simple language of the theory and practice of this wonderful art and to explain as far as possible the importance of the position occupied by wireless telegraphy to-day and the possibilities of to-morrow.

Improved Maritime Telegraph Service

Important improvements are being made in the telegraph service of Prince Edward Island, to meet both the growth of existing traffic and the further expansion which the operation of the new car ferry will entail. The rate of 30 cents per 50 words for night letters, which has been in effect on the mainland for some time, was extended to include the island offices on November 7, 1912, and was at once availed of very eagerly. Moreover, during the summer and autumn of 1912 five gangs of linesmen were engaged in rebuilding and improving the telegraph lines throughout the province under the direction of the leading construction officer for eastern Canada of the Western Union Telegraph Company.

Most important of all, negotiations have been active and thus far successful for the laying of a new multiple cable across Northumberland Strait to supplement the present cable connecting Prince Edward Island with the mainland. This new cable will cost approximately $45,000, and will contain one wire each for the Dominion Government and the existing telegraph system. These wires will handle principally the extra business caused by the car ferry, but they will incidentally furnish an emergency connection with the mainland for general purposes whenever the present cable may be out of order. In addition to the two wires mentioned the new cable will for the first time provide permanent telephonic communication across the strait.

Cable connection across Northumberland Strait was first established by the New York, Newfoundland & London Telegraph Company in 1853, and this line is said to be the oldest submarine cable in active operation in North America. In 1869 the Island government contracted with the company above named for a new cable to be subsidized annually in the sum of $1,947. In accordance with this agreement the cable was laid in 1873, being an unused end of the Atlantic cable of 1866. In the same year, when Prince Edward Island became a part of the Dominion, the Government of Canada placed itself under statutory obligation to support adequate telegraphic communication with the mainland, and accordingly took over the subsidy agreement of 1869. In 1904, in order to secure for the island equal rates with the mainland as well as better night and delivery service, the Dominion increased the subsidy by $5,000 per annum, so that the present payment aggregates $6,947. In the autumn of 1911 the cable and telegraph facilities of the island were acquired by the Western Union Telegraph Company, through a 99 year lease commencing on January 1, 1912. The system thus taken over consists of 317.5 miles of land lines on Prince Edward Island, about 9 miles of cable from Cape Traverse to Cape Tormentine, and some 35 miles of land wires from the latter point to Sackville, in New Brunswick. The current is supplied by gravity cells instead of the storage batteries which have been coming into use on the mainland. There are 28 telegraph offices upon the island.

New Cable Rates

It is announced that a new agreement has been completed between the Newfoundland government and the Canadian Marconi Co., whereby the number of stations in Newfoundland will be increased from five to ten, and the Canadian Marconi Co. undertakes to operate them until the year 1926. The company will receive from the government a subsidy of $4,500 per annum and other minor considerations in exchange for exclusive rights in Newfoundland until that date. As a result of this arrangement it is also stated that rates for through messages to and from ships at sea and any inland telegraph point in Canada or the United States will be lowered.

A recent advice from London stated that further reductions in cable rates would take place on January 1st. The rate for deferred telegrams to Newfoundland and the United States is reduced by 1½c per word for messages sent via the Anglo-American Cable Co., direct to the United States. The Western Union Cable rates for day and week end cable letters to the same countries will also be reduced and the periods of the delay decreased. In the case of cable letters the rates for places in the east of Canada and the United States is reduced from 6s for 24 words to 3s for 13 words and instead of being delivered on the second day after they are despatched, will reach addresses the day after. The new rate for week end cable letters is 4s 6d for 25 words to be delivered on Monday instead of Tuesday as at present. The rates for both classes of telegrams to other places in Canada and the United States vary according to the service.

A series of week-end cable letters will be inaugurated with Australia, New Zealand and certain British South African points. The charge for week-end cable letters to Australia and New Zealand is 18s for 24 words and 5d for every word over this limit. This rate will include the charge for delivery by post from the offices of the cable companies in Australia, New Zealand and South Africa.

Electric Trucks

The Eugene F. Phillips Electrical Works, Limited, have recently purchased a G. V. one ton capacity electric industrial truck. This truck is supplied with an electrically operated crane mounted on the front. This crane is used for loading material from the floor to the truck and from the truck to the cars or the reverse. Both the truck and the crane are operated by storage batteries.

Steel Belting for Power Transmission

The use of steel belts in some of the large manufacturing establishments of Huddersfield during the past year has been most satisfactory. At a local mill a steel belt 7⅞ inches wide, weighing 119 pounds, performs the work formerly done by a leather belt 22 inches wide, weighing 814 pounds, driving 300 horse power. In another mill a steel belt 3½ inches wide, weighing 12 pounds, does work in driving 40 horse power that formerly required a leather belt 12 inches wide, weighing 64 pounds. The steel belt is an economizer of space, does not slip or stretch, and gives the greatest efficiency of power delivery. A government test has shown a saving of 61 horse power on a drive of 640 horse power in using the steel belt.

New Developments, Improved Designs, 1912

A Brief Review of the Trend During the Past Twelve Months in the Different Phases of Modern Electric Practice (concluded)

The Electric Vehicle

Probably the greatest advance has been made in pleasure vehicles, though noticeable progress has also been made in commercial trucks. For pleasure vehicles the coupe type of body continues to be the most popular, improvements in design having made this a most attractive and comfortable vehicle. The five-passenger electric cars, a novelty of a few years ago, are now quite popular.

Better operating characteristics are shown, due to improvements in motor, controller, battery and transmission. The motor is more efficient and rugged, quieter and lighter in weight. Chain drive is being largely replaced by some form of gear drive in which the motor is either mounted directly on the rear axle or on the chassis and connected up by a jointed shaft. Improvements have been made in the chassis and body rendering entrance and exit easier as well as making riding more comfortable. Cars are more easily taken care of due to simplified charging devices available for garages. Central stations are appreciating more and more the value of an electric vehicle load and many of them are establishing charging points at different places in and out of the congested districts.

The limited capacity and slow speed objections often raised against the electric vehicles are gradually being eliminated though the electric car is not yet and probably never will be a competitor of the gasoline car. It is developing a field of its own which will be limited to city and residence districts where it promises to far excel the gasoline car. The manufacturers now realize that "record" trips mean little to the reputation of an electric vehicle and places this car in a wrong light before the purchasing public.

The electric truck is increasing in numbers at a remarkably rapid rate. Companies, including various industries which had tried them out in individual cases are now using them in large fleets.

Excellent and accurate data of operation and maintenance which has been secured and distributed by the manufacturers of electric trucks are doing much to advance the cause of the electric. The Electric Vehicle Association of America and several of the largest central stations have also done much to promote the use of electrics by publicity along broad lines. Another particularly interesting feature and a very praiseworthy one is the close co-operation of the three interests most intimately affected, namely: The manufacturers of the vehicle, the manufacturers of its component parts, and the central stations which supply the current.

The past year has seen the establishment of a very promising factory in Canada. The product of this factory appears to have gone a long way towards the solution of many of the problems which have retarded the more general use of electric vehicles in the past. Capacity is greater, the speed is higher, the life is longer, and the general design of the car seems to assure great popularity for this electric machine when it is placed on the market in commercial quantities.

General Illumination

Illumination as a science has made distinct advances during the year and it is coming to be recognized that in the past much good light has been used to poor effect and much work has been badly done for lack of knowledge of the requirements of scientific distribution of the electric units. It has come to be recognized that the cost of a proper lighting installation is small as compared with the increased quality and quantity of work that an individual can perform under the more favorable conditions.

In the home and office indirect and semi-indirect illumination have made noticeable progress. Improvements in reflectors, the better placing of units, and the greater consideration that is being given to the proper type of ceiling has done much to reduce the cost of indirect lighting. The semi-indirect, perhaps a more pleasing form, is now being treated very scientifically and with much less loss of light. A type of indirect illumination which has recently been brought into Canada requires the use of an arc lamp surmounted above an indirect reflector. This type of indirect is very efficient and doubtless will do much to increase the popularity of indirect illumination.

In street lighting, while the five-light standard using tungsten lamps is still being very generally installed even in our smaller towns and in some cases in our villages and along country roads, there is a decided tendency towards single light ornamental standards which offer greater efficiencies in operation. In certain cases one large tungsten unit is used but in a number of noticeable installations, an arc lamp surrounded by a large globe is the source of light. These are especially applicable to streets comparatively free of trees as the source of light is rather too powerful to be placed less than fourteen to sixteen feet from the ground

Household Appliances

As stated under the heading "Small Motors," much work that was formerly performed by hand is now being automatically taken care of by small motors. The washer, the wringer, sewing machines, grinders, etc., are increasingly popular. Electricity has now been adapted to practically every operation in the home and these are rapidly coming to be looked on as necessities rather than, as a few years ago, as luxuries. This equipment is becoming more efficient, more compact, will last longer and costs less to operate than formerly. Perhaps the greatest advance has been made in the electric radiator of which there is now a great variety on the market and although these are yet looked upon as somewhat of a luxury, yet, considering the added advantages of cleanliness, cosy appearance, and sanitary considerations, there are many instances where energy is cheap enough to outweigh all disadvantages.

Arc Lamps

Developments during the year have been confined almost exclusively to flame carbon arc lamps of the long burning type. Ten to forty hour lamps have been used very extensively abroad for some time and their general adoption in this country has been only delayed by the comparatively high maintenance cost, resulting from the necessity of frequent trimming and high price of carbons.

The long-life lamp however, is overcoming these obstacles and is now being used in large numbers not only for street but also for display lighting and especially for industrial plants, wharves, docks and large public buildings. The fact that carbons giving either white or yellow light may be used, renders the adaptability of the lamp more flexible. The rapid and very satisfactory progress made by carbon manufacturers in providing suitable carbons has materially

aided in the development of the arc lamp and its adoption. One company at least is utilizing an arc lamp for indirect illumination and a suitable type is being adapted to ornamental standards and promises to take the place of the five light tungsten clusters. Inasmuch as the demand is always for more light at a lower maintenance cost, the outlook for the arc lamp is very bright.

Rectifiers

The vibrating type rectifier has just been placed on the market. This will very satisfactorily take care of the charging of batteries used for vehicle lighting and gas engine ignition purposes. It is neatly designed, compact and light, and may readily be carried on the vehicle and is of particular benefit to the motor car owner who has a three-cell battery equipment as it enables him to charge the batteries at his convenience with small expense, directly from an alternating current lighting circuit.

The apparatus consists essentially of a polarized relay acted upon by two alternating current magnets so that it vibrates in synchronism with the alternations of the current, and arranged to reverse the connections of the circuit as the current reverses. The vibrating arm is magnetized by current from the direct current side, so that one end is permanently north and the other end permanently south, depending on which way the battery is connected. The two stationary electromagnets are wound so that their upper ends are of the same polarity at each instant. When the alternating current is in one direction the upper poles of both stationary magnets are north, attracting the south end of the vibrating arm and repelling the north end. This connects the alternating current to the direct-current circuit in one direction. When the alternating current reverses, the poles of the alternating current magnets become south, attracting the north end of the vibrating arm and repelling the south end. This reverses the connection of the alternating current to the direct current circuit, but as the direction of current has also reversed, the current flows into the direct-current circuit in the same direction as before. The reversal of the connections thus takes place every time the current reverses, so that the result is a pulsating direct current. A transformer reduces the voltage to the proper value.

Small Motors

No radical change in the general features and design of either a.c. or d.c. small motors has been made, but progress is noted in the details of design and process of manufacture tending to lighter weight, more compact construction and reliable operation. Materials are used to better advantage than formerly and a.c. and d.c. motors of the same capacity are practically interchangeable in so far as mounting is concerned, a feature of great importance to manufacturers of motor-driven machines. Improvements have been made in the starting torque and centrifugal clutch of the single phase motor enabling it to take care of the majority of starting conditions met with. The range of application of the small motor is wide, but the demand during the past year has centred in the home and the office, more particularly on washing, dictating, tabulating, mailing and similar machines and vacuum cleaners. The increased demand has resulted in larger production, which in turn has lowered the price to the user. The public is now getting to look on these and other electrical appliances in the light of necessities rather than luxuries, and the small motor may now be regarded as a commercial article with a field of its own. Especially it is noticeable that they are being used more and more in connection with labor-saving devices, and as a result have been the means of increasing the amount of useful energy expended by the individual, because it relieves him of the amount of physical energy necessary to perform the labor which the motor now does and gives him time to devote his energy to more profitable ends.

Steam Turbines, Condensers and Gas Products

The character of steam turbine business during the past year has been a general broadening of the lines. Large, complete expansion machines are coming very much into demand. Several negotiations are in progress, which involve the use of machines of 25,000 to 30,000 kw. capacity. Bleeder turbines, a more or less recent type, have justified the expectations of those who were responsible for their original design, and are being built now in sizes as large as 4,000 kw. Non-condensing turbines have also been built of 3500 kw. capacity within the year. The small turbine continues to develop very rapidly.

Lightning Arresters

The electrolytic lightning arrester in the higher voltages has been changed so as to include smaller diameter tanks. The same degree of insulation is obtained by lining the tanks with a substance which is absolutely impervious to water, thus providing constant and adequate insulation at all times.

For the highest voltages, this type is now supplied upon special order with elliptical instead of round tanks. These tanks allow of mounting two stacks of trays side by side, and this design is used where there is not sufficient head room to allow for the standard round tanks with all trays in one vertical stack.

Installation in Mond Nickel Mine

The conditions in the North Ontario mining district were from the start very favorable to the introduction of electric drive for all mining purposes. Fuel is very expensive in this district and the mines are often located a very great distrance from the trunk lines of the railroads so that the transportation of fuel becomes a serious problem. On the other hand, the country has many water falls which can be used for the generation of electrical energy with a very small amount of investment for maintenance. As a result of this all the larger properties in the Ontario district operate their hoists, pumps, blowers, etc., by electrical energy, which sometimes is transmitted over long distances.

One example of such an installation, which has been in

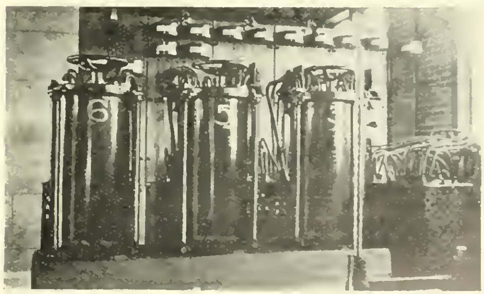


Fig. 1. Potential type motor starters, Mond Nickel

operation over ten years, is the mine of the Mond Nickel Company at Mond Nickel located on the C. P. R. The company produces a rich nickel ore from a mine of approximately 1000 feet depth. The ore is reduced in the company's smelter at Mond Nickel to which it is conveyed by means of a cable-way. The company has its own power station from which power is supplied over a high tension line to the mine sub-station and to the sub-station at the smelter. The

sub-station is located approximately four miles from the smelter and railroad station.

The mine hoist is partly shown in Figs. 2 and 3. It is a double drum hoist and is driven by a 300 h.p., 550 volt, Allis-Chalmers-Bullock slip-ring type motor. The motor is controlled by a Cutler-Hammer series relay type, reversible controller installed to the right of the hoist motor. Fig. 2, which is in turn controlled by a master drum shown mounted on the operator's platform in Fig. 3. The controller consists of two double pole, alternating current contactor switches with blowouts for the control and reversal of the primary circuit, and a number of double pole switches of the same design for the control of resistance in the secondary circuit of the motor. These secondary switches are in turn controlled by 3-phase series relays connected in the secondary circuit in such a way that they prevent the closing of the accelerating switches until the motor has come up to a certain speed and the accelerating current has dropped to a predetermined value, which can be varied by changing the adjustment of the series relays. The master drum is of the multi-step type and is an ordinary cylinder type drum controller by means of which the operator is enabled to start and reverse the motor and run it at any speed desired. Should he throw the master drum quickly to the fullspeed position, the motor resistance would not be cut out suddenly (which would result in a heavy overload on the line), but the acceleration is under the control of the series relays described above and the motor will come up to speed gradually without line troubles and without injury to the motor winding. The hoist is stopped by means of hand operated brakes and is further equipped with an emergency brake, which is set by a falling weight, this weight being held suspended by a latch. On failure of the line current, this latch is tripped by an alternating current solenoid and after the current is re-established the brake is re-set by hand. The motor-starting control apparatus was furnished by the Cutler-Hammer Mfg. Co. of Milwaukee.

In the sub-station there are three transformers which step down the high tension to 550 volts, at which voltage all motors are operated. The sub-station also contains one 300 h.p., 550 volt, motor-driven turbine pump for draining the mine, two 75 h.p. motor-driven blowers and one 300 h.p motor-driven air compressor. The last mentioned motors are all controlled by means of drum type potential starters, shown in Fig. 1. These potential starters are mounted in front of the switchboard, which carries the necessary indicating instruments and the oil switches for the individual motors. The drums are of the cylinder type and all contacts are oil-immersed. The leads are brought out through the cover of the controller and are sealed with an oil-proof cement, which prevents creepage of oil along the leads. The top forms, at the same time, the support for all contact parts and for the oil case, which consists of a seamless tank. This tank may be lowered by means of crank and chains below the floor line so that all contact parts are readily accessible for inspection. The top cover rests on a cast iron ring which is supported from the floor by means of three gas pipes. This type of vertical drum for large size potential starters is very satisfactory for the reason that it can be mounted in front of the switchboard in such a manner that the drums are directly opposite the indicating instruments on the switchboard, so that while starting up the motors the operator has a close check of the starting current, voltage, etc.

The ore is transported from the mine to the smelter, a distance of approximately four miles, by a cable way, which is driven by a 30 h.p. motor. The cable way goes over very rough country where the cost of building a railroad would have been excessive. It would also have considerably increased the operating expenses.

At the smelter there is a second sub-station with the necessary step-down transformers and a number of blowers and compressors for the operation of the converters. Besides these an a.c.-d.c. motor-generator set supplies direct current for the motors operating the converters, the cranes and similar machinery. The smelter has installed at the present time two converters which work up to their full capacity.

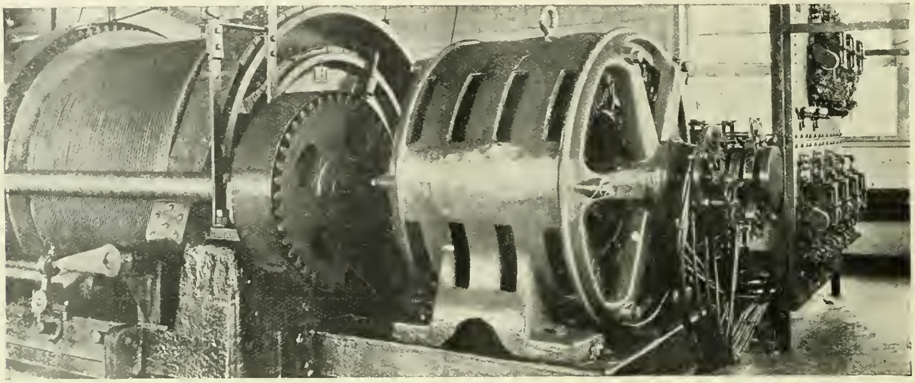


Fig. 2 Right hand drum of double-drum mine hoist driven by slip-ring motor, Mond Nickel Mine

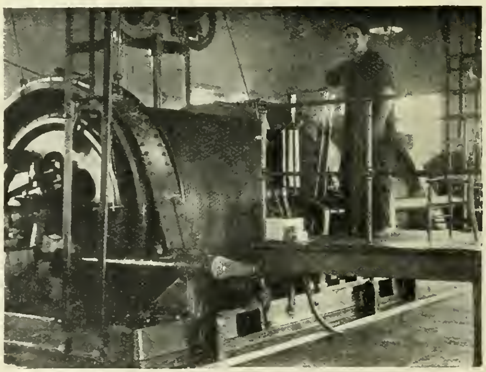


Fig. 3—Another view of double-drum mine hoist.

High Frequency Tests on Line Insulators

A paper was recently presented before the American Institute of Electrical Engineers by Mr. L. F. Imlay, superintendent of the Niagara Falls Power Company, and Mr. Percy H. Thomas, on the subject of high-frequency tests as applied to line insulators. The occasion for these tests arose when it was found desirable to raise the transmission voltage on a certain line from 22,000 to 38,000. Experience had shown that the old insulators occasionally punctured through the head from lightning, such failures being very difficult to locate. Further, this sort of failure was very unexpected in view of the fact that these insulators had never punctured under test though they would arc over when wet at about 90,000 volts, 25 cycles.

This discrepancy between the repeated punctures through the head from the conductor to the pin due to lightning and the immunity of the insulators to puncture on a 25 cycle test led to a systematic high frequency, high voltage test which is described in the paper. The tests in the laboratory were made to determine the difference in the behavior of insulators under a high frequency current and under a 60 cycle current.

The apparatus is illustrated and described in detail by which the authors were able to produce a current with a frequency in the neighborhood of 1,000,000 cycles per second or higher. The highest voltage obtainable along with this high frequency current was in the neighborhood of 300,000 to 350,000 volts. It is suggested in the article that while this voltage figure probably falls quite short of that experienced from a lightning flash, the figure for the cycles may have been comparable with that of lightning.

The tests made are outlined in detail but the general result may be expressed in a few words. It was found that under high frequency test, insulators in general punctured much more easily than under a 60 cycle strain. Often it was found that insulators which flashed over at a certain voltage with 60 cycles would puncture below the flash-over voltage under the high frequency test. Indeed, the paper states that the results showed most plainly that this resistance of the insulator to high frequency stress bore little relation to its strength against the normal 60 cycle stress. Also this was found to be true of insulators manufactured of different materials, electrose and porcelain being both subjected to similar conditions.

It is suggested by the authors, and a number of experiments were performed to verify this point, that the peculiar effect of a high frequency current is due to a different distribution of electric stresses produced under this condition, which distribution may be assumed to cause a concentration of potential at certain points. Following the description of the apparatus and tests the authors discuss the probable explanation of the observed results and draw certain conclusions, a resume of which is given below.

Discussion of Tests

"Unless there is some reason for believing that the tests are only of limited application or are rendered misleading by some unobserved condition, they mean that many of the line insulators now in service may be expected to break down by puncturing under the attack of lightning rather than by discharge over the surface, as is recognized as the desired characteristic. And this in spite of the fact that these insulators may have been thoroughly tested on normal frequencies in the usual way and may have then always flashed over the petticoats as intended. The fact shown in these tests, that an insulator which did not puncture at 250,000 volts on 60 cycles (under oil), punctured after a comparatively few shocks of high frequency discharge, and without apparently opposing a resistance of much over 100,000 volts, shows how little can be determined from the 60-cycle tests as to the lightning resisting capacity of an insulator.

While none of the tests were on trains of suspension insulators, the question immediately arises whether the same effects, that is, local concentration of voltage with high frequency shocks, will not cause these insulator trains to puncture relatively easily from lightning even when withstanding satisfactorily the most severe tests of the usual sort. Such failure is very likely to be expected. High-frequency tests on such insulator trains should be made by all means, and without delay.

The conclusion also is forced upon us, that if high tension line insulators are to be adapted to resist lightning to the best advantage, the design of many of them should be radically changed. Such a design study will require much patient investigation. In view of the importance of these conclusions, a critical examination of our tests was made for the purpose of discovering any improper methods or errors that might account for the great weakness of the insulators under high-frequency shocks; nothing, however, so far has been found to explain more than a very small portion of the very great discrepancy between the results of the two types of tests.

One very significant point is that no insulator failed on high frequency on the very first shock. In fact the strain of repeated shocks seemed to be far more severe than that of a few. Probably there is a progressive hammering out of a path through the solid material of the insulator. It will be immediately suggested, that this effect may be due to a progressive heating of the material by conduction or dielectric hysteresis, but we are inclined to doubt this. In-

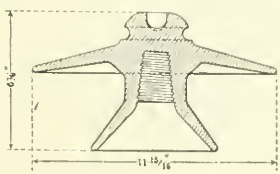


Fig. 1—Original Insulator

vestigations were made by exploring with the finger during the tests and, while after a puncture, which would of course be followed by some arcing, there was often a very noticeable rise of temperature at the puncture, exploration before an actual puncture but after the occurrence of many shocks showed no detectable preliminary heating. Furthermore there seemed to be no difference in the behavior of electrose and porcelain. This matter of dielectric loss and heating is, of course, one of the matters that should be carefully followed up in future tests along these lines.

It has been suggested by some that porcelain deteriorates in quality with time or exposure to the weather. This hypothesis is supposed to explain the fact that insulators which stand up under tests and during the initial months of actual service then seem to fail far more readily at a later time. It is suggested by the behavior of the insulator of our tests that there was progressive deterioration under the intense stresses of these experiments (or under the attack of lightning in actual service), which while due to electrical forces are of a physical nature. This would be somewhat analogous to the well-known mechanical disintegration of

the surface of glass under repeated surface sparking. In this view, the repeated attacks of these tests represent the anticipated effect of several seasons of lightning storms; to put it another way, the tests serve as a measure of the service durability of an insulator, as far as lightning and static are concerned.

The probability of the trustworthiness of these tests is greatly increased by the behavior of insulators in actual service, where punctures of a surprising character have occurred at the time of lightning or other disturbance of a static nature. We are informed that trains of suspension insulators and also pin type high tension insulators which are carefully designed and shown by test at normal frequency to flash over before they puncture, still do in practice actually puncture under lightning strains. It is a fact, however, that many of these insulators at other times do actually flash over in actual service instead of puncturing under static stress, showing that either all insulators or all stress conditions are not the same. This matter cannot be finally cleared up without much experiment and research.

Of the most interest and importance is of course the explanation of the cause of the great observed discrepancy between the effect of high-frequency tests and commercial frequency tests. It is too early to speak with certainty, but there is little doubt that the principal cause is the concentration of potential with high frequency upon some local part of the insulating material with the result of the breaking down of this portion and the throwing of the potential on some other part which is then also broken down. This general phenomenon is well-known in related situations; for example, in the behavior of trains of small air gaps in high-tension lightning arresters.

If a resistance and a capacity are connected in series and so adjusted that a given voltage at 60 cycles is evenly divided between the two, and the same voltage at a much higher frequency is impressed on the two, it will be found that the resistance then receives nearly all the voltage and the condenser practically none at all. The same would be true to an even greater extent were an inductance substituted for the resistance. An adjustment may easily be arranged in which at 60 cycles the condenser will take all the voltage and at the high-frequency the resistance would take all the voltage. In applying this principle to insulator service, it must be remembered that the change in frequency between 60 cycles and the frequency of lightning is enormous, the ratio being somewhere of the order of 1 to 1,000 or 10,000, which gives range enough to permit even a small tendency of 60 cycles to be transformed into a dominating effect on the lightning frequency.

It will naturally follow from the conditions indicated by these tests, assuming that they are confirmed by later investigators, that it will be desirable to modify our methods of testing insulators for practical work by adding tests of their behavior on high frequency. Such tests presumably need not be made on all the individuals entering into a plant, but on each type, to show that the design is satisfactory. Such tests will be difficult to make, in the first place, because very high voltage and large capacity are necessary for making the tests, and second, because these tests are dangerous to the testing apparatus used and because so far there is no knowledge as to what limits of frequency, voltage, electrostatic capacity or number of repetitions of attack are necessary to give a proper measure of the conditions of actual service. These service conditions will undoubtedly vary greatly in different localities. It can be suggested here only that further study of these phenomena be made as speedily and as exhaustively as practicable.

In the matter of new designs of insulators to resist high frequency discharges, much research should be done, but there are some guiding principles already clear. First, the more widely the live conducting parts of an insulator are separated from the pin, the less will be the stress. Second, the more nearly uniform the electrostatic field between these elements is, the better the condition. Third, wide and thin petticoats add very little strength to the high-tension insulator, for the electrostatic capacity of the surfaces of the outer parts is very great with regard to capacity of the parts near to the pin. It is very likely that the capacity of the wide petticoat of the insulator of Fig. 1 plays little part in its behavior on high frequency, since the potential stresses may be transmitted through the petticoat by virtue of the capacity of the lower surface in relation to that of the upper surface. This would account to some extent for

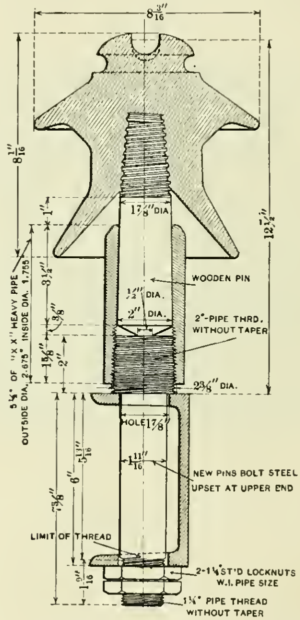


Fig. 2—Section of Insulator Finally Adopted

the behavior observed. It is significant that the type which stood best, had short and thick petticoats placed low down with regard to the pin top. The heavy ball of insulating material at and around the head of the pin is very likely the chief reliance of the insulator on high frequency. It will be noted that the design of the present suspension insulator has some points of disadvantage from the point of view of static stresses, if these tests are to be relied upon.

Fig. 2 shows the insulator and pin finally adopted by the power company. The pin consists of an iron base for attachment to crossarm, and metal sleeve with conical bore to receive a wooden pin, which is secured in place by the pressure produced in screwing the sleeve and base together. The wooden pin is impregnated with bakelite to prevent absorption of moisture. No attempt was made to cement the pin in the insulator, but this can readily be done if experience indicates that it is desirable. The insulator thus mounted on the combination wood and iron pin will withstand a breakdown test at 60 cycles between a conductor in the tie-wire groove and the iron pin, of 120,000 volts, dry, and 85,000 volts wet. It is highly probable that if time had permitted a better design of insulator could have been developed, but the construction of a new line was under way and the order for insulators had to be placed."

Earthed vs. Unearthed Neutrals in A.C. Work

By J. S. Peck, M. I. E. E.

The questions where, when, and how should the neutral point or points of an alternating-current system be earthed are highly controversial ones, and though they have been discussed a number of times before the technical societies there are still wide differences of opinion among operating engineers as to the proper course to follow under different conditions. While it is difficult to give general rules covering all cases, there are certain conditions where the proper course to follow seems clear, and it is intended in this paper to discuss the various questions involved, and to show why under some conditions of operation it is becoming general practice to earth the neutral, while under others it may be advisable to operate with the neutral unearthed.

Three classes of apparatus or systems will be considered.

1. Generators.
2. High-voltage transmission circuits.
3. Low-voltage distribution circuits.

Before considering these three classes separately, the general advantages and disadvantages of the earthed neutral which are common to them all will be considered.

While several advantages may be claimed for the earthed neutral, there are but two which are really of any great value. These are:—

(a) The limiting of the voltage between line wires and earth.

(b) The possibility of cutting off any wire or feeder in the event of an earth upon it.

The chief objection to earthing is the fact that the system cannot be operated with an earth on any line wire.

It is well known that in an unearthed 3-phase system, where the impedance of each phase to earth is the same, each of the three conductors assumes a potential above earth equal to 58 per cent. of the voltage between wires while the neutral point is at earth potential, but any difference in the impedance causes the potential of the neutral point to shift bringing the phase having least impedance nearer to earth potential and raising the others to a potential correspondingly higher above earth. When one phase is earthed, it assumes earth potential, and the other phases reach full-line potential above earth. When the potential of each phase to earth is the same, the charging current to earth will be equal in all phases, but when one phase is earthed the charging current to earth is increased by 73 per cent. in both of the unearthed phases, and all of this current will return to the generator through the earthed phase and will pass into the faulty wire at the earthed point.

Earthing the neutral means that this point is fixed at earth potential, and the three-line wires are fixed at a potential 58 per cent. above earth.

If the neutral point is earthed through a resistance and one phase is earthed, current flows through the neutral resistance, and the drop across this resistance measures the voltage between the neutral point and earth, so that the neutral point is not fixed definitely but depends upon the amount of resistance and the current flowing through it. Thus the conditions are intermediate between those with the unearthed neutral and with the neutral solidly connected.

With the earthed neutral very simple and reliable apparatus can be provided, which will cut out any feeder in case an earth occurs upon it. This apparatus may be of the Merz-Price balanced protective type, or it may be of that type which is based upon the principle that the resultant current in a 3-phase circuit is zero. Fig. 1 shows a well-known arrangement of this kind. It is evident that under normal conditions the resultant current in the secondaries of the three transformers is zero, therefore no current can flow through the trip coil; but should an earth occur on one of the wires, the circuits will be unbalanced and current will flow through the trip coil. This apparatus may be adjusted to work on a very small earth current.

*Presented before the Institution of Electrical Engineers.

Still another possibility is to put a trip coil in series with the earth connection, but this arrangement is not so satisfactory as those previously mentioned, in that it does not discriminate as to the feeder to be cut off.

Where a large cable network is supplied from common busbars the arrangement shown in Fig. 1 may work satisfactorily without the neutral point being earthed. The reason for this is as follows:—

In the event of an earth on any wire, the charging current to earth on all of the cables on the system will be returned to the busbars through the wire which is earthed. Therefore the current balance on the earthed feeder will be upset and the circuit breaker operated. This arrangement is, however, limited to its application, and is not so positive as when there is a current flow between earth and generator neutral.

1. Generators

All modern 3-phase generators are insulated to stand operation without the neutral being earthed, so that no consideration of reduced first cost due to limiting the voltage to earth by earthing the neutral need enter the problem. Also the question of risk of breakdown with earthed or unearthed neutrals may also be practically neglected.

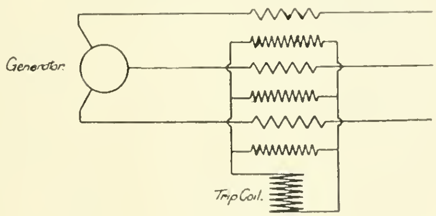


Fig. 1

When deciding upon the advisability or otherwise of earthing the neutral of a generator, consideration must be given to the service for which it is to be used. Three classes of service will be considered:—

(a) Generator supplying network of underground cables.

(b) Generator supplying overload transmission circuits without transformers.

(c) Generator supplying overhead transmission line through step-up transformers.

In case (a) an earth on any phase of a cable is almost certain to develop into a short circuit between phases, and on a large system the result of a short circuit on a cable is usually to burn off a section of the cable, perhaps to damage adjacent cables, and sometimes to set up surges which may cause serious breakdowns elsewhere on the system. Since the majority of breakdowns on cables are to earth, it is therefore extremely desirable that a cable be cut off as soon as an earth develops and as this can be done quickly and with certainty where the generator neutral is earthed, it is becoming general practice to do this in all stations of this class. Thus practically the only question to consider is whether the neutral should be earthed solidly or through

a resistance, and, where there are several generators in parallel, how many of them should be earthed. The only object in inserting resistance between generator neutral and earth is to limit the rush of current which occurs whenever there is an earth on the system. If balanced protective apparatus is used, similar to that shown in Fig. 1, the resistance may be made so high as to keep down the current rush to a comparatively low value, because the protective apparatus may be set to operate with a very small unbalancing in current; but where plain overload protection is used—and this applies to the majority of cases—the resistance should be low enough to pass sufficient current to trip the breakers on the largest feeder, but high enough to prevent damage to generator windings, and, if possible, to prevent serious burning at the point of accidental earth.

In calculating this resistance, allowance should be made for the drop in voltage on the generator due to the load on one phase, also for the resistances in neutral earth connection in the feeder and at the point of accidental earth.

In designing the resistance, ample heat capacity should be allowed, for the circuit breakers may stick, or there may be at least temporarily a fairly high resistance at the point of accidental earth which will prevent the circuit breaker from opening immediately, and so give time for the resistance to reach a high temperature.

In general, earthing resistances are built up of cast-iron grids mounted on porcelain insulators, and should be located in a fireproof compartment. They are usually designed to have sufficient heat capacity so that full star voltage may be maintained across them for at least 15 seconds without a temperature rise of approximately 300 C. being exceeded. The ohmic value of the resistance is determined by the current required to trip the breakers on the largest feeder.

Earth Through a Resistance

Where it is desired to earth through a resistance, and two or more generators are operated in parallel, the simplest and best method in so far as earthing is concerned is to connect the neutral of all the generators to a common busbar which is earthed through a suitable resistance. Then, regardless of the number of generators, the value of the earth resistance will always be the same. With this arrangement switches must always be provided between each generator and the neutral busbar, otherwise a generator disconnected from the main bus and shut down may be raised to a dangerous potential above earth, in case of an earth on any feeder. The objection to this method of connection is that in certain cases very heavy currents may circulate through the neutral connections and generator windings, and while the deleterious effect of this current has been greatly overestimated, it appears in certain cases it has been almost impossible to operate with the neutrals connected solidly together. When the wave-forms of the different machines are exactly the same, no current can flow through the neutral connections, but when the wave-forms are different and there is a third (or multiple of three) harmonic present, current will flow through the neutral connection, the amount of which will depend upon the value of the third harmonic, the displacement angle, and upon the impedance which the generator offers to this current of triple frequency. Machines which at no load give no circulating current, may show heavy circulating currents as the load comes on, or vice versa. The amount of the circulating current also depends upon the adjustment of the field current of the different machines, and upon the angular variation in speed of the prime movers.

In certain abnormal cases the current in the neutral may amount to the full-load current of one generator or even more. It should be noted, however, that the neutral current divides equally among the three phases of the generator, so that full-load current in the neutral is equivalent to only 33 per cent. full-load current in the windings of the generator, and since the heating in the windings is equal to the sum of the squares of the main and circulating currents, the resultant heating is increased by only 11 per cent. —not a serious amount even with this very high value of circulating current. With 30 per cent. of full-load current in the neutral the resultant heating in the generator is increased by only 1 per cent. at full load and is quite negligible.

Connect Neutrals Solidly

It would seem advisable, therefore, to try connecting the generator neutrals solidly together, especially in the case of turbo-generators, where there is no angular variation in speed, and therefore less chance of circulating currents. Should satisfactory operation be impossible, then only one generator should be connected to the neutral bus, or resistance may be inserted between each generator and the neutral bus.

Of the three methods, that of connecting the neutrals solidly together is undoubtedly the simplest and best, while the method of operating with an earth on only one generator comes next in simplicity. The switching on and off of the different generators to the neutral bus may be done automatically, as at the London County Council Greenwich generating station, or it may be done by hand. While the latter method depends upon the memory of the station attendant, or upon the systematic operation of the station, the fact that the attendant may forget to connect a machine to the neutral busbar does not mean disaster, as it is only in case of a cable breakdown that trouble may occur, and it must be remembered that many stations are operating successfully with an unearthed neutral.

Where resistances are used between each generator and the neutral bus, a very considerable expense is involved in providing these resistances, and it is often difficult to find room in the station to accommodate them; also the resistance in the earth circuit is much less when there are several generators in parallel than when only one is in use.

(b) Generators supplying Overhead Transmission Line without Step-up Transformers.—In this case there are usually a comparatively small number of transmission lines, and an earth on one wire is not likely to cause a short circuit between wires, so that with an unearthed neutral it is quite possible to run for a long period with one wire earthed. If there are not sufficient feeders to all distributing centres to make it possible to cut out a defective one and deliver full load over the others, the possibility of being able to operate with one wire earthed may be sufficient far to outweigh the only practical advantage gained by earthing the neutral, which is the ability quickly to cut off a feeder in the event of an earth upon one wire. Limiting the voltage between each wire and neutral, which can be done by earthing the neutral, is of very little importance, since the voltage is no case very high, and the generators and the line must be insulated to withstand strains set up by lightning discharges and other abnormal conditions. It would appear, therefore, that in the majority of cases the weight of the arguments are in favor of operating with the generator neutrals unearthed.

(c) Generators supplying Transformers which Step Up to a very High Voltage for Long-distance Transmission.—In this case there are conditions involved which make it extremely desirable to earth the neutral or else to earth the low-tension side of the transformers.

If one terminal of the high-tension side of a single-phase transformer be connected to a high-tension line, and the low tension be open-circuited, the high-tension winding assumes a potential above earth equal to that of the line to which it is connected. The high-tension winding then acts as one plate of a condenser, with the low tension and

core as the other plates. The low-tension winding also has static capacity to the iron, and it will therefore assume a potential above earth the value of which will depend upon the relation between its capacity to the high tension winding and its capacity to earth. In practice it may easily assume one-half the potential of the high tension winding (see Fig. 2).

If—

K = capacity between high tension and low tension.
K_1 = capacity between low tension and core
V = voltage of high-tension line
V_1 = potential of low-tension winding above earth

$$V_1 = V \times \frac{K}{K_1}$$

If both terminals of the high-tension winding are connected to the high-tension lines, the resultant potential of this winding above earth will be zero, and the resultant potential of the low-tension winding above earth will also be zero. If, therefore, one terminal of a transformer be connected to or disconnected from a line before the other, the low-tension winding during this period may assume a very high potential above earth and its insulation be broken down to earth. When the low-tension winding is connected to a generator, the generator winding also has capacity to earth, so that the capacity of the low-tension winding to earth is increased by this amount and its voltage correspondingly reduced. If the capacity of the generator winding to earth = K_2, then the voltage of the low-tension circuit above earth $= V \times \frac{K}{K_1 \times K_2}$. Thus, while the voltage is reduced by connecting the transformer and generator windings together, it may still be dangerously high.

When both terminals of the high-tension winding are connected to the line and one wire is earthed, the resultant voltage of the high-tension winding above earth will be V/2, and that of the low tension winding will be one-half as great as before, but may still be dangerously high.

In the case of a 3-phase transformer the conditions are much the same as described above for a single-phase transformer. If one terminal of the transformer is connected to the line, the whole of the high-tension windings will be raised to full-line potential above earth, and the low-tension winding will be raised to a correspondingly high value. If the three terminals of the high-tension winding are connected to the line and one line wire be earthed, the resultant potential of the high-tension winding will be 58 per cent. of the line voltage above earth, while the low tension will be 58 per cent. of its former value above earth.

It is evident that when the neutral of the high-tension system is unearthed there are several possibilities of obtaining a high voltage on the generator windings, viz., in the case of an earth on one high-tension wire, or in the case of the switches in the three phases not operating simultaneously. It is not necessary that a line wire should be permanently earthed in order to raise the voltage on the low-tension circuit, as a discharge over a lightning arrester may so disturb the static balance of the system as to produce a high potential on the low-tension winding.

A case is on record where several generators in parallel were suppiying a very high-voltage line through step up transformers. The neutral point of the generators was unearthed. The lightning arresters on one high-tension phase broke down and the generator windings were raised to a high potential. One generator broke down, and the attendant, seeing smoke, cut it off the busbars. A second machine immediately broke down, and was in turn cut off. This was repeated until nearly all the generators in the station were broken down. The attendant then cut off the excitation. Had the neutral point of the generators or that of the high-tension side of the transformers been earthed, the trouble could not have occurred in the generator circuit. There is, however, a chance of similar trouble even when the high-tension neutral is earthed, provided the generator neutral is unearthed. This occurs when the insulation between the high and low-tension windings of the transformer breaks down at one point. The low-tension winding then assumes the potential of the high-tension winding at the point of connection, and a breakdown on the low tension system is almost certain to follow.

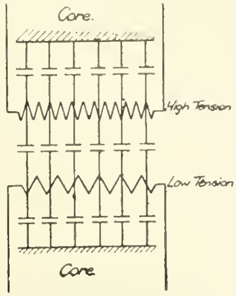


Fig. 2

With electrolytic lightning arresters it is necessary to connect the aluminium plates to the lines at frequent intervals in order to preserve the film on the plates. These plates have a high electrostatic capacity, and a considerable charging current flows through the arrester while it is connected to the line. It has been found on one system that when the arresters are being charged, disturbances are set up on the system and breakdowns have occurred on secondary circuits. It is quite possible that this trouble is due to the static unbalancing of the high-tension circuits, which in turn raises the secondary circuits to a high potential above earth.

Where it is considered undesirable to have a direct connection between low-tension windings and earth, a spark gap may be placed in the circuit and set to break down at a pressure slightly above the normal voltage of the winding above earth.

Another method of protecting the low-tension system in the case of breakdown between the windings of the transformer is the use of earth shields between primary and secondary windings. This system was at one time in general use in this country, but it is now scarcely ever called for. The objections to it are:—

(a) Increased transformer cost.
(b) Increased risk of transformer breakdown.
(c) No protection when breakdown is between leads or anywhere except between transformer coils.
(d) The danger that earth shields may become displaced.
(e) The leads connecting earth shields to core may be broken due to vibration or to settling of core and coils, or they may be burned off due to heavy charging current which may flow over them.
(f) Part of earth shield in the neighborhood of fault may be burned away and leave primary and secondary windings connected together with no earth on the system.

While it may be argued that many of these difficulties are due to defective manufacture, and should not occur provided proper precautions are taken, there is always the possibility that they may occur, and the practical impossibility of inspecting the earth shields after the coils are assembled makes it almost impossible to determine their condition.

This in the case of generators supplying a high-tension transmission line through transformers, it is highly desirable to earth the neutral point of the generators, and preferably through a rather low resistance. If it is not desired to connect permanently to earth, then a spark-gap should be used in the earth connection.

2. High-voltage Transmission Circuits

The arguments in favor of earthing the neutral in the case of high-voltage transmission circuits are:—

(a) The possibility of cutting off the circuit in case of an accidental earth on any wire.

(b) Reduced cost of transformers and of line insulators due to limiting the voltage above earth to 58 per cent. of line voltage.

(c) Reduced cost and closer possible setting of lightning arresters.

(d) The possibility of using the earth as a conductor in the event of one line wire being disabled. This requires an earth at both ends of the line.

The argument against earthing the neutral is that an earth on one wire makes it impossible to transmit over the circuit.

(a) Whether there is any advantage in being able to cut off a circuit in the event of an earth on one wire depends upon the number of circuits available. In general, there are seldom more than two circuits to any sub-station, and often there is but one, so that cases may often arise where, to keep up the supply, it will be absolutely necessary to operate with one wire earthed. This method of operation would be impossible with an earthed neutral. Also an earth on one wire is not likely to develop into a short circuit between phases, so that there is no particular need for cutting off the earthed circuit.

(b) The higher the voltage of the transmission the greater will be the saving in first cost made by insulating the transformer for 58 per cent. of the line voltage and by using the line insulators for a corresponding voltage; but in general it is bad practice to adopt this expedient, for it may prove impossible to operate continuously with an earthed neutral, due to disturbances on adjacent telephone circuits which may occur under certain abnormal conditions, and in the event of an earth on one wire it may be essential to remove the neutral connection and operate with one wire earthed. In general it is poor economy to cut down insulation on either lines or transformers.

(c) If the system may sometimes be operated without earthed neutral the lightning arrester equipment must be suitable for this condition, so that there is no saving in first cost; but as long as the system is operating properly with earthed neutral the arresters may certainly be set for lower discharge values than when the system is unearthed.

(d) In the event of one wire on an earthed system going to earth, it would still be possible to transmit approximately two-thirds the full amount of power over the two remaining wires, provided the neutral points at both ends of the line were solidly earthed and one line with its corresponding transformers cut out of circuit. In this case the earth would carry full-line current, and in very few places would this be allowed on account of disturbances to neighboring circuits.

The neutral point of a high-tension system can be obtained only by connecting the high-tension windings of the transformers in star, or by the use of an auto-transformer, and this latter method is seldom if ever used. If the high-tension windings are connected in star, then damage to one transformer disables the whole group, while with the delta connection on both windings one transformer of the group may be cut out and approximately two-thirds the capacity supplied from the remaining transformers. (This does not hold in the case of 3-phase core-type transformers, but is true for single-phase and 3-phase shell-type transformers).

The conclusions to be drawn from the above are that in the great majority of cases continuity of service will demand that the system be operated with an unearthed neutral, and that in general the transformers should be connected in delta on both high-tension and low-tension windings.

3. Distribution Circuits

When it comes to a study of the question of low-tension distribution circuits, the majority of the arguments presented above will apply here also, but there enters one other consideration, i.e., the danger to human life.

If the neutral point of, say, a 500-volt system is earthed, then the maximum potential above earth which any point of the system can reach is 290 volts. If the system is supplied from a 500-volt generator, the difference between a 500-volt and a 290-volt shock may mean the difference between life and death, or it may not, and there is certainly greater risk of shock from a system which is permanently earthed than from one which is earthed only occasionally. The higher the voltage of the generator the less will be the value of the earthed neutral in preventing danger to life due to reducing the voltage to earth.

Thus, where the distribution circuit is supplied direct from a generator, the advantages of the earthed neutral are the ability quickly to cut off a defective circuit and a possible reduction in risk of life, due to lower maximum voltage to earth; but where the circuit is supplied through step-down transformers from a high-voltage line, there is danger to life and apparatus if the neutral is unearthed.

Where a single-phase circuit is supplied from a single-phase transformer, the low-tension winding should be earthed, preferably at the middle point of the winding, but it is better to earth one line wire than to leave the system unearthed.

Conclusions

1. Generators.—When generators supply a system of underground cables, the neutral should be earthed through a resistance. This makes it possible to isolate a cable in the event of an earth on any phase before such an earth develops into a short circuit.

When generators supply overhead circuits, it is a question of balancing continuity of service against the ability to cut off a feeder in case of an earth upon one wire. If there are comparatively few feeders, and these of large capacity, the balance will usually be in favor of not earthing, but each case must be considered individually.

When a generator supplies transmission lines through step-up transformers, the neutral should always be earthed or connected to earth through a spark-gap, otherwise the generator windings may be raised to abnormally high potential above earth. The neutral may be earthed direct, though a comparatively low resistance will usually be preferred.

2. High-voltage Overhead Transmission Lines.—In this case the number of circuits supplying any particular district is ordinarily very small, and as an earth on any one wire is not likely to develop into a short circuit between phases, considerations of continuity of service will usually determine that the high-tension system should be run without an earthed neutral and with both windings of the transformers connected in delta.

3. Distribution Circuits.—When the working circuits are supplied direct from a low-voltage generator, the advantage in earthing the neutral is the possibility of cutting off immediately any defective feeder, and when the necessary apparatus is provided for this purpose earthing will in general be preferred.

When the working circuit is supplied from a transformer stepping down from a high-voltage line, the neutral should always be earthed.

Possible Heat Economies in the Boiler Room

By Mr. A. H. Blackburn*

The first step toward improvement of steam plant economy is an analysis of losses. The largest item of power plant expense is the fuel bill, and at the very beginning of the process of utilizing the fuel, we encounter one of the greatest percentage losses. To burn each pound of fuel, from 18 to 24 lbs. of air are, or should be, introduced into the furnace to bring about complete combustion and to set free the 12,000 to 14,000 heat units that the pound of coal may contain. Assuming that 20 pounds of air are used and that to heat each pound of the gases of combination one degree Fahrenheit will require 0.23 heat units, the gases resulting from 1 lb. of coal require 20 x .23 = 4.6 heat units to raise their temperature 1°F. and 12,000 to 14,000 heat units would raise the temperature of this gas approximately 2,500 deg. F. The temperature in the furnace after complete combustion should therefore be about 2,500 deg. F. above the temperature of the atmosphere.

The temperature of steam at 150 lbs. gauge pressure is 366 deg. F., and if all the heat in the gases above this temperature could be transferred to the water and steam of the boiler, the efficiency of the boiler, assuming an atmospheric temperature of 60 deg. F., would be 88 per cent., leaving only 12 per cent. of the heat of the coal to escape in the chimney gases at a temperature of 366 deg. F.

As a matter of fact, however, no boiler reduces the temperature of the gases to the temperature of the steam. To do so would require an infinite extent of heating surface, for as the temperature of the gases approaches that of the contents of the boiler, the rate of heat transmission per sq. ft. of boiler surface falls lower and lower, as it is proportional to the difference of temperature between the gases and the water in the boiler. There is, therefore a limit to the boiler surface that it pays to put in. Beyond a certain point the interest and other fixed charges on extra boiler surface would amount to more than the value of the heat regained. Commercial practice has established this limit of surface at about 10 ft. per boiler h.p., but experience shows that a h.p. can be produced from much less surface—from 3 to 5 sq. ft. or even less—and in some plants it is becoming customary to drive the boilers at 60 per cent. above the nominal rating of 10 sq. ft. per boiler h.p. It should be borne in mind that the question of heating surface has, in reality, nothing to do with the steam liberating capacity. No matter what the extent of the heating surface the boiler must have large enough steam drums or other provision to separate the steam from the water without priming.

With the number of sq. ft. of boiler heating surface ordinarily employed to produce a boiler horse power, it will be found in commercial plants that the chimney gases escape at temperatures between 450 deg. and 700 deg. F., representing a waste of from 15 to 30 per cent. of the heat of the coal, depending partly upon the amount of air used to burn a pound of coal. In a 1,000 h.p. plant, running 24 hours a day for 360 days per year, with a load-factor of 50 per cent. and burning coal, costing $2.50 per ton, a 25 per cent. waste of coal amounts to $6,000 a year, not counting handling charges, and it will therefore pay to study how it may be wholly or in part prevented. This problem has engaged the attention of steam engineers from the first, and many solutions have been proposed.

Chimney gases can obviously be used only for heating boilers at a temperature lower than themselves, and in order that the transference of the heat from the gases may be rapid enough to make it worth while, the body receiving heat should be at a considerably lower temperature. The contents of the boiler are at too high a temperature to utilize this heat. The most available means for utilizing this energy is in heating feed water. To burn a pound of water at 60 deg. F. into steam at 150 lbs. gauge pressure requires 1166.5 heat units, of which 309.7 are consumed in heating the water up to the temperature of ebullition, namely, 366 deg. F., while the remaining, or 856.8 heat units, are used in turning the water into steam at the same temperature. The heat required for merely heating the water is thus 26 per cent. of the whole, which, as will be noted, is about equal to the percentage of the heat of the coal present in the flue gases when they escape from the furnace.

It may be asked why it is not possible to feed the water into the boiler cold and to allow it to re-capture this waste heat from that position. Aside from the injurious strains set up by feeding a boiler with cold water, there is another important fact that must not be overlooked, and that is, that the transmission of heat from the gases to the water is proportional to the difference between the temperature of the two, and if we can bring the cold water before it has entered the boiler, into contact with the hot gases it will absorb the heat much faster through 1 sq. ft. of heating surface than it will if we put it into the boiler and allow it first to mingle with and be warmed by the large body of hot water there present. Obviously, the feed water should be heated in a vessel separate from the boiler and receiving gases of combustion after they have passed through the boiler. This is the correct application of the counter-current principle to boiler practice.

The Economizer

The problem of devising an efficient apparatus for this purpose was first taken up by Edward Green, of England, in 1845. After experimenting with a great many types of apparatus and with different arrangements and kinds of tubes, he finally settled upon an arrangement substantially identical with that now in general use. This apparatus, well named by its inventor, the Economizer, consists of a stack of vertical cast iron tubes, each about 4⅝ inches in diameter and 9 feet long, pressed into top and bottom headers to form sections of the desired number of pipes, which sections are in turn placed side by side to form an economizer of any desired length and capacity. Ordinarily, the water is introduced to the bottom headers by a branch pipe running along one side of the economizer and the hot water is taken from the top headers by another branch pipe running along the diagonally opposite corner of the assembled economizer. The amount of economizer surface that should be installed in any given case can only be determined after a careful consideration of many factors, including the amount of fuel burned, the size and type of the boilers, cost of the coal, load-factor, etc. A general practice is to install half as much economizer surface as boiler surface, but where the boiler surface is driven considerably above the ordinary commercial rating this would be too little.

The size of economizer required to effect a given result may, however, be easily calculated with fair accuracy. Suppose that the temperature of the water entering the economizer from the hot well of the condenser is 105 deg. F., and that the final temperature desired is 260 deg. F., or a total rise of 145 deg. F. Suppose, further, that the temperature of the gases leaving the boiler is 600 deg. F. Now say that 10 lbs. of water are evaporated per lb. of coal burned

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and that 20 lbs. of gases are discharged for each pound of coal, giving 2 lbs. of gas per lb. of water. Assuming the specific heat of the gases to be .23, it will be seen that for each degree rise of the temperature of the feed water, the gases will be cooled off a little more than 2 deg. F., so that the total fall in temperature of the gases will be 2 x 155 = 310 deg. 600 deg. — 310 deg. = 290 deg. F. is, then, the final temperature of the gases leaving the economizer. Now a boiler horse-power is represented roughly by the evaporation of 30 lbs. of water per hour. To heat 30 lbs. of water through 155 degs. will require 4650 heat units, so we must install enough economizer surface for each boiler horse power to transmit 155 heat units per hour when the average temperature of the gases is $\frac{600 + 290}{2} = 445$ deg. F. and the average temperature of the water is $\frac{165 + 260}{2} = 182.5$ deg. F., that is, when the average difference between the gases and water is 445 deg. — 182.5 = 262.5 deg.

Extensive experiments have shown that the amount of heat transmitted through an economizer surface per sq. ft. per hour per degree difference of temperature Fahrenheit is from 2½ to 4 British thermal units. Taking 2½ to be on the safe side, we find that in the above case each square foot will transmit 262.5 x 2.5 = 655 heat units per hour and to transmit 4650 heat units per hour will require $\frac{4650}{655} = 7$ sq. ft. of economizer surface.

To illustrate the foregoing remarks I will refer to the performance of several economizers installed in well-known plants. Dean and Main, consulting engineers, of Boston, made tests some time ago on the Green fuel economizer installed in the Natick Mills in connection with a B. & W. boiler, having 3,467 sq. ft. of heating surface. During the test a steam pressure of 150 lbs. gauge was carried and 10,216 lbs. of coal were burned during a period of 11¼ hours, converting 94,734 lbs. of water at 40 deg. F. into steam at 150 lbs. pressure gauge. The temperature of the gases leaving the boiler was 416 deg. F., an exceptionally low figure, while the temperature of the water leaving the economizer was 165 deg. F. The conditions here would usually be considered unfavorable for a large showing by the economizer, since the gases leaving the boiler are comparatively low in temperature. By comparing the results obtained with the economizer with an identical test made two days later without the economizer, it was found that the coal saving, as represented by the lbs. of water evaporated per lb. of coal, was nearly 14 per cent., although the difference of the feed temperature would have given only 10.8 per cent. increased evaporation by the common rule of 1 per cent. for each 10 deg. rise. This brings to our attention a fact very often encountered in the comparative economizer tests with and without the economizers, namely, that the actual coal saving is greater than would be computed from the ratio of the heat supplied by the economizer to the total heat required to turn the water into steam. Several explanations of this fact have been attempted, the most likely of which is, that by furnishing part of the heat the economizer diminished the work of the boiler heating surface and the amount of coal that is burned upon the grates, and it is known that boilers and furnaces as ordinarily installed fall off slowly in efficiency when the load is increased beyond a certain amount. By the installation of suitable means of burning efficiently the larger amount of coal upon the grate this relation might be changed, but the fact that the actual coal saving is greater than the theoretical has been frequently noted in tests. Results in other plants are shown in the following table:

Test No.	Boiler surface sq. ft.	Econ surface sq. ft.	Steam pressure lbs.	Temp. F. flue gases leaving boiler	Temp. F. water entering econ.	Temp. F. water entering boiler	Saving %
1.	3,126	1,920	68.2	435	84.2	196.2	12.5
2.	9,000	11,520	120.3	620	101.	237.	18.3
3.	33,380	98,340	166.	548	96.	200.	9.2
4.	14,000	4,608	150.7	389	103.	202.7	12.4
5.	9,543	4,749	78.2	535	184.5	265.2	

In none of these plants, as will be noted, were the gases from the boilers at a particularly high temperature. When high temperature gases are available, much greater savings can be realized by the economizer, as will be apparent from the results secured in the following plants. At the Daubhill Brickworks, Bolton, the average flue temperature was 650 deg. F. The economizer raised the feed temperature from 52.1 deg. F. to 259.5 deg., thus saving 21 per cent. of the coal. At the works of Dickens and Haywood, Middleton, the temperature of the flue gases was 655.25 deg. and the economizer was able to raise the feed from 59.6 deg. to 301 deg., saving 24.7 per cent. At the mill of A. Scott & Sons, Oldham, the temperature of the flue gases was 721.6 deg., the feed was raised from 50 deg. to 291 deg. and the saving was 26.18 per cent. At the Manchester Union Warehouse, a flue temperature of 675 deg. was found, which made it possible to raise the feed from 113.3 deg. to 282 deg., giving a saving of 20.2 per cent. The economizer in the plant of A. Scott & Sons contains 216 tubes, and as the plant burns over six tons of coal per day of ten hours, the economizer more than pays for itself every year.

It should be pointed out in this connection that modern practice is inevitably in the direction of higher temperature of the gases leaving the boiler. Steam pressures are constantly being carried higher, and as the boiler cannot in any way reduce the temperature of the gases below nor even anywhere near the temperature of the steam, the temperature of the flue gases will rise in consequence. For instance, with a boiler pressure of 200 lbs. gauge the temperature of evaporation is 387.5 deg. F., under which condition the temperature of the gases leaving the boiler will probably be well above 500 deg. F. Where a superheater is employed in connection with the high pressure, a good arrangement is to place the superheater in a by-pass for the gases, thus securing along with a convenient and safe location of the superheater, a low final temperature of the chimney gases and high fuel economy.

So far we have dwelt entirely upon the fuel saving effected by the use of economizers, but there are several minor advantages which should be mentioned. For one thing, it increases the steaming capacity of the boiler, that is, by supplying 10, 15 or 20 per cent. of the heat required to turn the water into steam, it permits the boiler to evaporate that much more water without increasing the virtual rate at which the boiler heating surface is driven. This feature is especially important in plant subject to sudden and very heavy overloads, in which case the boiler is still further aided by the fact that the economizer holds in reserve a large supply of hot water. Where 5 sq. ft. of economizer surface per boiler horse-power are installed, this supply of feed water, heated up nearly to boiler temperature, is sufficient for about an hour's run. The protection given to the boiler in the way of avoidance of straining of seams and rivets through heating the feed water is well recognized, since it is known that if the cold water discharge upon one portion of a boiler shell should reduce its temperature by 170 deg. F., the stresses set up would be in the neighborhood of 30,000 lbs. per sq. in.

ELECTRIC RAILWAYS

Trunk Line Electrification*

By Mr. N. W. Storer

The supplying of motive power is one of the most important elements of railway transportation. For many years the steam locomotive had a complete monopoly of the business and, like some other monopolies, it lacked the incentive of competition. Since the electric locomotive entered the field, however, there appears to have been a great awakening among steam locomotive designers. The improvements in the steam locomotive, such as mechanical stokers, superheaters, smoke consumers, etc., have led to the production of the enormous units that are now standard. These great machines have produced such excellent results that the electric locomotive no longer has such comparative advantages as were apparent even ten years ago; and, while the electrification of a large part of our railways will undoubtedly be accomplished at some time, the improvements in steam locomotives have removed the crying necessity for it, except in special instances. It would be a great mistake to compel the railways to electrify too rapidly; it would be far better for them to study the subject with the greatest care, and finally to unite on the best system and then proceed with electrification in places where there will be distinct economical advantages. In large cities especially, it is of the utmost importance that the railways unite and give every plan most careful consideration before starting actual work.

The manufacturing companies have done a tremendous amount of work in developing the various systems of electrification, and in the design of electric locomotives. They have learned many things about locomotives. They have found that low center of gravity in the electric locomotive, instead of being an advantage, is a decided disadvantage. They have also found that because an electric motor develops its power by rotation it is not necessarily easy for it to turn the wheels of a locomotive. For some years it has been recognized that one of the greatest problems in the electric locomotive is the transmission of the torque of the motor to the driving wheels. There have been a great many combinations proposed and quite a large number of different types have been built, and are now in operation, but there are few transmission systems that are absolutely satisfactory from all points of view.

In this respect, as in most others, every design is a compromise among the conflicting elements, not simply in the locomotive itself, but on the roadbed and shop as well. It is recognized that, in proportion as a locomotive is built up around one idea in its design, it will be distorted, and other things will be neglected. It is, therefore, necessary that a careful study of the entire problem of railroading be made in order to produce the best type of locomotive. Progress in heavier railway electrification is analogous to that of the development of street railways. The early forms of railway motors and controllers were designed, to a great extent, in the laboratory; but as time went on the designers became more and more imbued with the spirit of the operating man and with the problem in general, and from the constant association with those men and the study of the problems in the field, they developed street railway motors and controllers to their present high state of perfection. The same plan should be followed in connection with the electrification of railways. The best locomotive is the one that will deliver the transportation required of it with the lowest sum total of expense. This must include not simply the first cost and cost of maintenance and depreciation of the locomotive itself, but the first cost and cost of maintenance, depreciation and operation of the entire installation from power house to roadbed.

The standard type of single reduction geared motor has been eminently satisfactory for street car service, but the difficulties connected with it have increased enormously as the power of motors and speeds have been increased, until to-day it is considered poor practice to gear locomotive motors directly to the axles, except for slow-speed work. Several reasons have contributed to this belief:—

1.—The gears are subject to very severe service when run at high speeds and rigidly connecting so much inertia as is contained in the wheels and armatures, and to still greater shocks from the roadbed. In the operation of high speed railways using single cars or multiple-unit trains, there has always been more or less trouble from gears with speeds around fifty and sixty miles an hour. The gears and armatures both suffer and there is always a great increase in the cost of operation, especially if the track is poor. The motor on one axle is subjected to worse punishment than that on the other. The trailing axle has the pinion of the motor pushing downward on the gear teeth, and the other axle has it pushing upward. The motor whose pinion is driving downward usually fares much worse both in gears and in the armature windings, due to the blows that it gets from the roadbed. When a wheel comes to a depression in the track, it is suddenly lifted as it climbs out, and gives a direct shock to the teeth of the gear, that tends to retard the whole armature.

2.—The weight of the motor on the axle, and its low center of gravity, contributes to serious injury to the track when operated at high speeds. Chiefly for these reasons, the speed of most locomotives, having heavy motors geared directly to the axles, is limited to about thirty miles per hour.

This geared type of locomotive is comparatively simple, cheap and easy to maintain, but when the design of a locomotive for high speed service is considered, the problems to be solved are many and difficult, and the solutions that have been offered are almost as numerous. It is, of course, comparatively easy to design motors that are sufficiently large and powerful to equip any locomotive that is desired. The big question is, how to connect the motors to the driving wheels so as to give a locomotive that will have a reasonable cost of maintenance and, at the same time, be a good riding machine.

There are several general types of high speed locomotives:—

1.—Those with armature mounted rigidly on a driving axle.

2.—Those with motors mounted on a quill surrounding the axle.

3.—Those with motor geared to quill surrounding axles, and connected to wheels through long helical springs.

4.—Those with motors mounted in the cab and driving through a jack shaft and a system of parallel rods.

5.—Those with motors mounted low between frames and connected to the drivers through a Scotch yoke.

*From a paper read at a recent annual convention of the Association of Railway Electrical Engineers, Chicago.

6. —Those with motors connected to the wheels by some combination of gears and side rods.

1.—Armatures on Driving Axles

The first type, known as the New York Central type, may be called an example of a locomotive built around one idea, namely, that of mounting the armature of the motor directly on the axle, and building the motor field into the truck frame so as to do away with all motor bearings. It is a scheme that is ideal in its simplicity, and it is not surprising that the New York Central desired to use it. However, it is well known that the locomotives have never been considered as successful high speed machines, on account of the tendency to nosing. Many steam locomotives have some tendency to nosing, but it is not serious, as the mass of the locomotive is located so high above the rail. This type of electric locomotive has an extremely low center of gravity, so that it is quick to feel the irregularities in the track, and synchronous vibrations are very easily set up. A great deal has been done to eliminate this defect, but the efforts have been only partially successful.

2.—Armatures on Quills Surrounding Axles

This type, first used on the New Haven passenger locomotives, has the motors mounted on quills surrounding the axles and connected through springs, and is open to some of the same objections as the first type. It also has a low center of gravity although considerably higher than the first type, but all weight is spring-supported so that the track does not get a direct blow. The original New Haven locomotives nosed at high speeds, but this was cured by the addition of idle wheels at each end of the locomotive and a toothed cam centering device between the cab and the trucks. However, even with the motors carried by springs, the track is liable to damage unless it is kept in good surface.

3.—Motors Geared to Quill

The third type is one of the latest developments, and the New Haven and Boston & Maine locomotives of this type are the easiest riding electric locomotives that have been built. Mounting the motors rigidly on the trucks above the axles and gearing down to the quills of course raises the center of gravity very considerably. Then the long helical springs connecting the quills to the driving wheels permit the axles and journal boxes to move a total vertical distance of three inches in the pedestal jaws, before the quills touch the axles. Then the wheels are free to follow the inequalities of the track without disturbing the mass of the locomotive, and consequently with the least possible damage to the track. The arrangement of wheels, combined with the distribution of weight and the drive, entirely prevents nosing, and the secondary springs, transmitting the weight of the cab to the trucks through the large surface plates, prevent the transmission of vibration from the truck frame to the cab.

This type of locomotive has been built, both with a single motor per axle, and with twin motors of the same total capacity per axle. After building a number of the former, whose motors were so large as to require double gears, it was found that the same output could be obtained, with less weight and less cost, by substituting two motors for the one large one. This arrangement has the following advantages:—

(a) Only one gear is required, as both motors drive through the same gear.

(b) The two motors are lighter and easier to handle, and cheaper to maintain than the large one.

(c) The motors in this case may be made interchangeable, except field casting, with the motors used on multiple-unit cars.

(d) Two motors permanently connected in series give in effect one motor of double voltage and consequently half current. This reduces the carrying requirements of cables and switches to one-half, and thus makes a substantial saving in the cost of control equipment.

The spring drive eliminates the bad effects of the impact of the teeth when operating at a high speed, so that it is anticipated that the gear speed may be much higher than that of ordinary gears mounted directly on the axles.

While these locomotives are now built for single-phase operation, they would have practically the same advantages on direct current. The twin motor scheme adapts itself well to high voltage direct-current operation.

4.—Motor Mounted in Cab

The fourth type of locomotive has a very high center of gravity and, although the weight on the driving axle is about 56,000 lbs. and the springs are consequently stiff, the locomotive has excellent riding qualities. There is no tendency to nosing, and no bad effects on the track. The first locomotives of this type were those for the New York terminal of the Pennsylvania Railroad. These are the most powerful electric locomotives ever built, and have a record for the first year, with 33 locomotives in service, of 13 train minutes delay chargeable to the locomotive. They have developed over 75,000 lbs. tractive effort at the draw-bar. This corresponds to a crank-pin pressure of over 100,000 lbs. Of course, the normal pressure on crank pins is not nearly so high, but it is sufficient to impose strains on the jack-shaft bearings that are very hard to hold. These strains are worse than on reciprocating engines. There is scarcely any neutral zone, because of the combination of strains imposed upon it by the motor rods and driving wheel rods acting at an angle of about 45 degrees from each other. This angle, however, is much to be preferred to the vertical motor rods adopted for the first locomotives built for the German State Railways. These were practically failures, and it is understood that future locomotives will have motor rods similar to those of the Pennsylvania.

The use of side rods on an electric locomotive introduces some different problems from those found in the steam locomotive. As there are no reciprocating parts, such as piston rods, the parts are susceptible to perfect balance. The rods must be much larger than for corresponding steam locomotives, because the entire power has to be transmitted through one set of pins and rods at certain points in the revolution, while the steam engine transmits the power from only one cylinder. The steam engine has another advantage in that the main rods on the two sides of the locomotive are connected to loose ends (pistons), while the rods on the two sides of the electric are connected to opposite ends of the motor shaft, as well as the jack-shaft, which introduces a great many chances for inaccurate workmanship and consequent knocking in the pins and bearings.

5.—Motors Low Between Frames

The fifth type of locomotive has been used exclusively for the three-phase locomotives on the Italian State Railways. The first ones have been in service some ten to twelve years on the Valtellina line, and have given excellent results. The later ones, some 35 in number, have been used about two years on the Giovi line near Genoa. These machines have some excellent qualities, light weight, powerful motors, and motor weight entirely spring supported. They have, however, been used only in slow and moderate speed service, so their performance at high speed remains to be proven. These locomotives also require very accurate adjustment, although not so close as the ones with side rods and jack shafts, as the Scotch yoke drives one axle through a sliding block and the others through parallel rods connected to the yoke by knuckle pins.

6.—Motors Connected by Gears and Side Rods

A number of locomotives of this kind have been put in service, the most notable being those built for the Loetsch-

berg Tunnel in Switzerland, and for the Midi Railway in France. The former has two 1,000 horse power motors, each connected by a helical tooth gear to a jack shaft, which is slightly above the driving axles, and thence by parallel rods to three pairs of driving wheels. Although the motor speed is extremely high, the gears operate practically without noise and with high efficiency. The duty on the jack shaft bearings is much easier than when side rods only are used, since the reciprocating pressures are practically all in a horizontal direction, and can therefore be cared for much more easily. The Midi locomotive has two motors, each geared to a jack shaft through gears located outside the plate frames of the locomotive. The jack shafts are connected to the drive wheels through Scotch yokes, like the Italian locomotive. Either of these types has fairly high center of gravity and is therefore susceptible of a design that will have excellent riding qualities.

Any of the types of locomotives described, except the New York Central type, might be equipped with apparatus for any of the known systems. The New York Central type is suitable for direct current only. The New York, New Haven & Hartford locomotives, of both types described, are operated with single-phase alternating current motors on both alternating and direct current circuits. The Pennsylvania locomotive is for direct current, but locomotives of similar type are built in Germany for single-phase lines. The Italian locomotives are all for three-phase operation. The combination gear and side rod locomotives are both equipped for single-phase operation.

While most of these locomotives are equipped with alternating-current motors, this is only because it has been believed that alternating current is better suited for heavy trunk line electrification.

Other Considerations in the Choice of a System

If the choice of system rested only on the locomotive, undoubtedly the standard 600 volt direct-current system would be chosen in the large majority of cases as being the simplest and best adapted for the work. But for the electrification of trunk line, this is an economic impossibility, because with the low voltage, too great an expenditure for substations is required and a low efficiency results except with a traffic which gives a good load factor. Third rails must be used on account of the enormous currents required.

In order to reduce the number and cost of sub-stations, the voltage must be increased to a point that would prohibit the use of a third rail, even if it were not otherwise undesirable. It is therefore generally accepted as a fact that the current must be taken from an overhead trolley. It then becomes a question as to how much current can be collected from an overhead conductor. At slow speeds 150 to 200 amperes can be collected for a few seconds. A current of 200 to 300 amperes may be collected continuously at high speeds, either by wheel or some form of roller or sliding shoe. The wheel can scarcely be considered, but both roller and sliding pantagraph trolleys have been used.

It is of the greatest importance to have the overhead construction very flexible and to have the current collectors light. Otherwise there will be flashing, and the trolley will become kinked at every suspension point so that it will soon break. It is also undesirable to increase the number of collectors. All of these things tend to limit the amount of current that can be collected for a single train, and consequently render an increase in voltage necessary.

Locomotives of over 3,000 horse-power capacity have been designed, and it will probably be necessary at times to operate two such locomotives in a single train. Even with one of them operating at rating, a current of about 750 amperes would have to be collected with a voltage of 3,500 volts direct current. Granting that two collectors might be used, the current per collector would still be close to, if not beyond, the range of anything that has been successfully accomplished up to the present time in high speed service. It is believed that 3,500 volts direct current is about the lowest voltage that should be considered for high speed trunk line service, on account of the difficulties of current collection. Lower voltages may, of course, be used for lighter and slower service. Whether locomotives can be made commercially with this high voltage, remains to be determined. Even if locomotives were built, however, it is very certain that such a voltage is entirely beyond the range for multiple unit-car operation, so that any line operating at 3,500 volts direct current would be confined to locomotive service.

The single-phase system is the only one that has successfully solved the problem of current collection at high speeds. The usual voltage for heavy railway work in this country is 11,000. In Europe it is even higher, 15,000 for the Loetschberg tunnel line, and this will probably also be used in Germany in the electrification of the State Railways. Either voltage makes it a comparatively simple matter to collect current for the heavy high speed trains.

The New York, New Haven & Hartford Railroad, which is using the 11,000 volt single phase system, is steadily extending its electrification. It is practically the only company that is making such extensions. They have the Oak Point yards and the Harlem River division equipped now and are doing their switching with electric locomotives. They have suburban service on the New York, Westchester & Boston Railway, and they are rapidly extending the main line electrification to New Haven, so that in a very short time they will run from New York to New Haven with electric locomotives. At the same time, they are figuring on the line from Boston to Providence which will probably soon be electrified. Such extensions indicate that the system is satisfactory.

New Cars for O. E. R.

Some considerable extensions to the street car lines in Ottawa are proposed by the Ottawa Electric Railway. In the spring, work will be begun on the extension of the Bank street lines across the new bridge, spanning the Rideau Canal, to the city limits in Ottawa South, a distance of about a mile from the present terminus on Bank street. Twenty new cars are now being built by the Ottawa Car Company to be put on the Bank street lines when the new tracks are laid. These cars will be of the semi-convertible type with short platform and vestibule at the front end for control apparatus and a long platform at the rear end with railings, etc., arranged for the collection of fares by the p.a.y.e. system.

The general dimensions and carrying capacity of the cars are: length over bulkheads 33 ft. 3 in.; length over bunters 45 ft. 3 in.; length front vestibule 4 ft. 6 in.; length rear vestibule 6 ft. 6 in.; seating capacity 42 persons. The construction of the bodies will be what is known as the all steel frame with the main side plates forming the outside sheeting. The interior finish will be in red cherry with the panelling in the doors, etc., outlined with inlay lines of ebony and white holly. The ceilings will be of three ply wood veneer and painted.

The seats will be of the non-reversible type, upholstered and covered with metal spring rollers and Forsythe coach curtain fixtures. All fittings such as door handles, window locks, handrailings, etc., will be of solid bronze and of the most modern design and finish.

The trucks will be Brill, Standard No. 27 I E-I, 4 ft. 10 in. wheel base with Schoen rolled steel wheels. The motor equipments will be Westinghouse No. 101 B-2 four motors per car with one K 35 controller, one circuit breaker and Malloy trolley base. The air brakes will be Westing-

house schedule S-M-E, with D-2 motor driven compressor, type J compressor governor, 10 in. x 12 in. cylinder stock adjuster, reservoirs and other accessories.

Peter Smith forced ventilation and hot air heating system is to be used and C. C. H. Co's. buzzer signalling apparatus; Stanwood steel steps; vertical wheel hand brake and any other modern fittings and appliances that will tend to facilitate in the operation of the cars and add to the convenience and comfort of the passengers.

A 3200 kilowatt Westinghouse turbo-generator is now being installed by the Ottawa Electric Company in their power house on Montreal street, and will be in operation early in the spring. A Babcock and Wilcox boiler, marine type, will supply the steam for this generator. A building for the boiler has just been built, 90 x 40 feet.

A similar equipment is being put in for the Ottawa Electric Railway Company at their power house on Victoria Island. This will not be ready for use until the fall of 1913.

A New Feature Introduced

The floors of these cars are to be laid double thickness with heavy builders' tarred paper between. This is a distinctly new feature in street car building and one which promises to add greatly to the comfort of the passengers, both by making the car much warmer than the old style single floor and by acting as a muffler for the noise of the motors and running gear below.

Electrification of L. & P. S. Railway

The Hon. Adam Beck's attitude with reference to the electrification of the London and Port Stanley railway system has been considerably strengthened by a recent report of Mr. W. S. Murray, chief electrical engineer of the New York, New Haven and Hartford Railway system. Mr. Murray's report makes it plain that he believes that the expenditure necessary for the electrification of the L. and P. S. Railway would be justified. This is especially the case because of the cheap rate at which this railway system will be able to purchase its power, being .5 and .6 as compared with the average price of anywhere between 1 and 1½c per kw.h. Mr. Murray's report states that he has found from experience that a pound of coal burnt under the boilers of a central electric power station and the power transmitted in the form of electricity to the car motor will produce, under exactly the same conditions, approximately twice the tractive effort of a pound of coal burnt in the fire box of a steam locomotive. Considering the rate quoted above being so much cheaper than the average, the saving would be proportionately greater.

Mr. Murray further states that the flexibility and increased traffic capacity of electric over steam equipment offers at once a reduction in train miles due to the possibility of increasing train weights. In the operation of the New Haven road trains aggregating 1000 tons are operated by one locomotive, which, in the case under discussion, would mean that one train each way would probably be sufficient to attend to all freight transportation over this line for some time to come.

The Preservation of Ties

Mr. Robert Bruce of Alex Bruce & Co., Fort Frances, with head office Glasgow, Scotland, sailed for home on Jan. 4th after spending some time looking over the Canadian field and getting the Fort Frances plant operating. Before leaving Mr. Bruce stated that his company were at the present time turning out about 3500 preserved railway ties per day and that this number would be increased to 8000 by next spring. The process of preserving which Messrs. Bruce & Co. are using is a German process for which they own the sole rights in Canada. The mixture used contains zinc chloride and aluminum sulphate as its chief ingredients into which the ties are dipped. By this process it is claimed that the ties are made fireproof as well as waterproof and that they are quite odorless and colorless. At the present moment this company have sufficient orders on hand for railway ties to keep their Fort Frances plant busy for some time to come, but anticipating a larger demand they will erect plants at both Edmonton and Vancouver.

Miscellany

The report recently submitted by Superintendent McIntyre of the street railway department, Berlin, Ont., shows total revenue for the year, $45,858; total expenditures, $39,827; net balance, $6,031. This does not make allowance for depreciation. The light and power commissioners have later decided to set aside ten per cent. of the value of the machinery; five per cent. for rolling stock, and three per cent. for track, as a depreciation fund. This totals $5,120, leaving net profits for the year, $911. Waterloo gets twenty-five per cent. of this amount and Berlin seventy-five per cent. During the past year this road carried 982,750 passengers, an increase over the previous year of approximately 200,000. The operating expenses per car mile in 1912 were 22.4c as against 26.2c in 1911.

The B. C. E. R. Company are trying out a "Near-side" car. This car provides only one point of entrance and exit, namely, at the front, where both the conductor and motorman are situated on an unusually roomy platform. The same company has recently purchased a number of cars equipped with rear wire gates of the folding type. These cars are specially designed to prevent accidents. If these gates work satisfactorily, which they are reported to be doing at the present time, it is understood the company will install them quite widely on cars now in service.

The Niagara, St. Catharines and Toronto Railway Co. are planning for the erection of a new substation at St. Catharines of 1000 h.p. capacity and one at Niagara-on-the-Lake of 500 h.p. capacity. About 75 per cent. of the grading work is done between St. Catharines and Niagara-on-the-Lake. Poles are being erected and all work of track laying, etc., will be continued throughout the winter. It is anticipated that this line will be operating by June 15th.

The Ottawa Electric Railway Company have just completed equipping a new sub-station adjoining the car sheds on Albert street. A 650 kilowatt Westinghouse motor-generator set has just been installed. The company are contemplating putting in two more such sets in different parts of the city, at an early date.

The street cars were tried out for the first time on December 19th, but owing to a shortage of power, which will be supplied through a turbo-generator now being installed, a complete service is not expected before the middle of January.

The directors of the Windsor, Essex and Lake Shore Railway Company, A. Eastman, general manager, are reported to be considering the construction of an electric road to London.

The Toronto Railway Company are trying out electric signs on a few of their street cars.

Illumination

Ornamental Illumination

As indicating the progress of scientific and ornamental illumination at various points in Canada, the following recent contracts awarded to the Adams Bagnall Company for their pressed steel Luxolabra are of more than passing interest. For the most part this equipment is installed and all is delivered.

At the present time Galt is being supplied with about 200 Luxolabra standards, chiefly of the type known as No. 1—one light, shown in Fig. 2. These will be distributed as follows: Lansdowne avenue 26, Brant Road 52, Aberdeen street 12, Wentworth avenue 34, Crescent Road 12. All the number 1 type carrying a single 250 candle power tungsten lamp enclosed in a 16-in. globe. The town of Galt is also installing a number of five-light ornamental Luxolabra, including 12 on Dixon street and 20 on North Water street. Eighty-four of the single light type will also be run out Blair Road, a suburban residential district where these lamps will be placed about 200 feet apart. On West Main street Galt will also use 20 of the type shown in Fig. 2 and a number of three-light ornamental units similar to the five light units on Dixon street.

As indicating the high standard of illumination maintained in Galt, Fig. 6 represents a stairway leading up to the town park district. On each of the newel posts shown in this figure will be installed a pressed copper standard as shown in Fig. 5. These standards will be four feet six inches in height and will present a very beautiful effect.

The service wires for this work are placed underground, the current being carried by three wire, number 4 B & S,

Fig. 1

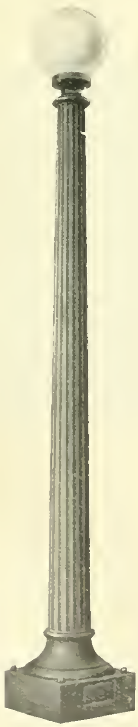

Fig. 2

Fig. 3

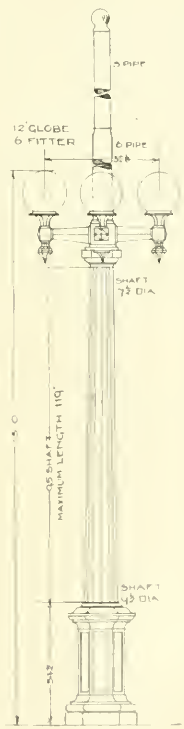

Fig. 4

Fig. 5

standard cables, leaden cased, paper insulated. This wire is being supplied by the W. T. Henley Telegraph Works Co.

Berlin is also installing some fifty odd poles of the type shown in Fig. 2, each carrying 250 candle power tungsten lamps. The distribution system in Berlin is all underground and equipped with 5 x 6 x 6 cement manholes with room for four 10 kw. transformers. At the present time one 15 kw. Maloney subway transformer is installed in each. From the manholes conduits have been run to each individual factory.

Fig. 6

Further installations include one in St. Catharines by the Lincoln Light, Heat & Power Company. This installation includes 36 five-light standards of the type shown in Fig. 1. Waterloo is installing eight units similar to Fig. 1, but carrying three lights. Dunnville has installed four five-light standards of somewhat more elaborate type.

Fig. 4 further illustrates a type of ornamental combination standard being tried out in both Galt and Berlin, the idea being that these two towns will, if the equipment proves satisfactory, be connected along the railway line connecting these towns by similar equipment. This unit is a combination ornamental light standard and trolley pole, which, however, are quite separate from one another. Vibrations from the trolley pole will not affect the lamps inasmuch as a washer cushion is installed between the pole and the hollow standard at the upper end of the latter. The joint at this point is also waterproof.

The City of Winnipeg is installing 100 Union metal pressed steel standards surmounted by G. E. magnetite arcs, Fig. 3. These standards are from 14 to 16 feet in height, have a burning life of approximately 100 hours, light capacity of approximately 1,600 candle power and are placed one hundred feet apart.

Calgary Arc Lights are Good

A Torontonian, prominent in electrical engineering circles, now touring the western provinces, writes from Calgary,—

"All the public utilities in Calgary are publicly owned—electric light and power, street lighting, street cars and telephones. The street lighting is splendid, particularly on the main business street, 8th avenue, where they have magnetite arcs, with opal globes, 110 feet apart on both sides of the street supported on the trolley poles. They consume no more current per lineal foot of street than the popular five light tungsten clusters, and give a very much better light. In many of the residential streets, magnetites, with clear globes, from 300 to 600 feet apart are used, and give good results. Of course there are no trees of any size in the streets to throw shadows."

Stratford, Ont.

The report for the eleven months ending November 30, 1912, recently issued by the Light and Heat Commission of Stratford, Ont., showed such a considerable surplus over all expenses that the Commission feel themselves justified in estimating the yearly surplus at $4,000. The report gives the total number of customers as 1,017, divided into 627 domestic, 314 commercial and 76 power. When the business was taken over from the private company in July, 1910, the total number of customers was 318. The commission is composed of Messrs. J. J. Mason, chairman, Angus McDonald and Mayor Brown.

High Tension Insulators

Mr. P. W. Sothman, formerly chief engineer of the Hydro-electric Power Commission of Ontario, and now head of the consulting engineering firm of P. W. Sothman & Co., Toronto and New York, recently presented a paper before the American Institute of Electrical Engineers on the subject of high tension insulators. Mr. Sothman's paper reviewed intimately the work done in connection with the selection of insulators for the Commission's 110,000 volt transmission line in southwestern Ontario.

Victoria, B.C.

The value of an auxiliary steam plant was demonstrated recently when the Jordan River hydro-electric plant of the B. C. E. R. Company was disabled during a heavy electric storm. This company has just recently completed a steam turbine plant, capable of developing six thousand horse power, which was in operation a few minutes after the damage to the hydro-electric units was reported. The accompanying cut illustrates the conditions under which power companies operate successfully in British Columbia. The photograph was taken at the Jordan River power plant.

Lightning flash taken at Jordan River power plant

The by-laws submitted to the ratepayers of Ottawa on Monday, January 6th, asking for permission for the Morrisburg and Ottawa Electric Railway to enter the city and also to allow the Ottawa Electric Railway to make some extensions in the suburbs were carried by big majorities.

The Dealer and Contractor

Contractors' Publicity and Advertising

The following extracts from an address recently delivered before the 12th annual convention of the National Electrical Contractors' Association, bear especially on the value of advertising to the electrical contractor.

Advertising may not be quite everything in business, but everything in business is advertising. We are advertised by all that we do. In a successful business, needless to say, the advertising is constructive even though there may be exceptions to prove the rule, and a business may prosper for a time in spite of poor advertising.

There are just two classes of electrical contractors,—the satisfied and the ambitious. To the first class this subject has no appeal; they have enough business, so why advertise? Why reach out for business To the second class I hope to relate a few experiences, and to give a little data which will be profitable. Advertising anticipates sales, whether sales of wire, of conduit, of labor, of brains or what not, for the whole aim and object of advertising is the increase of sales.

I have purposely inserted the word "publicity" in my subject because there is a vital distinction between publicity and advertising. Publicity plus salesmanship equals advertising. Publicity alone does not make sales. It lacks that element of vitality which points to the dotted line with the assuring confidence necessary to induce the customer to sign a contract or to order with a smile of satisfaction. Add your personality, your integrity and your sales instinct to your publicity effort, and the result is advertising, such as is now supporting twenty-three thousand newspapers, 34,000 magazines, and thousands of print shops doing an aggregate business of $137,000,000 per annum in advertising. Advertising expenditure of the country does not prove that all successful business houses are advertising, and advertising successfully—I am not so fanatical as to claim that—but it surely does indicate that the majority of successful business houses are advertising and that some of them are doing it pretty heavily. The fact that the publishing business has grown 25 per cent. during the past ten years, is proof that greater number of advertisers are spending greater appropriations and that in the majority of cases the results are such as to encourage further advertising. There is no doubt but that proper advertising does increase net profits, and that the subject must be considered by every business man who looks for commercial growth

I believe that conditions have changed very materially in the past year, and that almost every city has to-day, at least one electric shop that conforms to modern merchandising standards. The business-like clerks and demonstrators are more in evidence this year, and electric merchandising has grown from a mere interrogation point to a recognizedly successful business occupation. With this development, namely merchandising, which is really a great stride toward making the electrical contracting business more profitable, has come a more liberal use of advertising. Every merchant appreciates the use of advertising methods as a means of inducing prospective customers to enter his shop The two developments, merchandising and advertising, are inter-dependent If either is to be effective it must be supported by the other

The writer is most familiar with the results obtained in Cleveland, so you will grant him plenary indulgence if he talks of his home city. In Cleveland 16 electrical contractors have been advertising during the past year The largest expenditure for advertising space by any one contractor, has been $1,000, or about 3½ per cent of sales To this expenditure he attributes the securing of at least 20 per cent. of 212 house wiring contracts secured during a recent sixty day whirlwind campaign The average house wiring contract was for $40, and allowed for a profit of $8 or 20 per cent. The profit on the increased business in house wiring alone, would, on the above basis, net this one contractor over $331 in profits, while the increase in store sales, contracts pending but not signed, etc., swell the total so as to over balance easily, the $1,000 expended in advertising. However, advertising should not be figured on any basis whereby you expect to receive $1 to-morrow for 87 cents invested to-day. The cumulative effect of consistent advertising is of greater value than any immediate direct returns Just as the good will of a reputable established firm is often of more value than its tangible assets, so is the cumulative effect of advertising of greater value than the immediate returns. I have yet to learn of a single Cleveland contractor who has joined the advertising movement, who has not received his money's worth. Most of them have used the newspapers, not by taking large space, but by using small cards, which are quickly and easily read, and which keep the name and the service before the people. In three Cleveland newspapers a co-operative newspaper electrical advertising page, called the "People's Electrical Page," is maintained throughout the fall, winter and spring by the mutual efforts of the 16 contractors above mentioned, together with several manufacturers, the central station, and the telephone company.

Advertising Mediums

In addition to the newspapers, the telephone directory has been an effective medium of contractor advertising In one case space was taken on ten pages, which gave good representation on all pages listing electrical manufacturers, electrical engineers, illumination companies, and electrical jobbers The cost of this representation was $[illegible] and the advertiser places many telephone inquiries to the [illegible] directory advertising

The city bill boards and the flashing electric sign over the contractor's place of business have also contributed to the success of the general advertising by Cleveland contractors.

The use of the mail, especially for the distribution of high potential sales letters has proven mighty fruitful. I am somewhat of an optimist in regard to most advertising, but especially in regard to the use of personal letters One Cleveland contractor has been following the

plan of dividing the city into sections and canvassing one section at a time, to obtain complete data as to the possibility of wiring old houses. All prospects have been carefully listed, and letters have been mailed to every prospect. In each letter was enclosed a stamped return postal card. About 20 per cent. of these cards were returned, indicating the desire of the prospect to learn more about the cost of electric wiring. As the next step, these inquiries were followed up with personal calls, and good salesmanship brought back many orders which netted a profit.

There is little chance of a contractor becoming known to those needing his services unless he talks to more people than those reached by him personally, and there is no chance of landing contracts or orders unless he is known. One might meet personally, twenty persons a day, but through advertising he can become known to thousands in a short time. As Elbert Hubbard puts it, "One must make his money out of his friends: his enemies won't deal with him." Our friends are those who know us, and know our methods and ability; by modern advertising you can make friends with all prospects for the service you may offer. A man can't buy himself a character, and neither can the electrical contractor, but having the character and the ability to deliver the goods, he can buy himself a reputation,—by advertising.

The manufacturers, in particular the lamp manufacturers, are offering more extensive advertising assistance to contractors this year than ever before. The stand that so many contractors have taken regarding electrical merchandising, has given the manufacturers renewed confidence in the ability of the contractor to become an economical distributor of lamps, and they are, therefore, planning to assist him further in his advertising and sales. General publicity in the big popular periodicals will be a feature of this co-operation. The vast sums of money that will be spent in these mediums should be taken advantage of by every contractor.

Follow up Your Advertising

Follow your advertising closely, and show conspicuously that you have the goods for sale. Do this by means of the local papers, the street cars, the moving picture shows, and without fail, your own display windows. Take advantage of the aids that the manufacturers will offer you. Use the manufacturer's advertising services, ask him to formulate suggestions, and use them where you can. You may sell carloads of electrical goods, but the manufacturer has gleaned ideas from merchants in other places, and from contractors with other electrical merchant contractors with whom he deals. In any of your publicity it is well to ask the manufacturer for his co-operation. It is part of the service that helps at your disposal.

Perhaps the key-note of the assistance offered by the manufacturers in the sale of lamps, will be the travelling window displays which may be used by the contractor, as a feature window attraction. A large number of these features will be provided. They will be special attractions usually displaying lamps or electric light by motion and color. There will also be displays such as miniature houses, completely equipped electrically with moving puppets operating electric lights. Aside from these features, there will be special paper trims for the windows. By the use of the display window, any contractor may connect with the larger advertising campaign of the manufacturer.

The remarks that I have made might be summed up briefly in the form of a few suggestions.

Advertise, but have a plan back of the advertising.

(1) Use newspaper space, but use it discreetly. Take small space often, and keep your name and service before the people. Remember that a three-inch real estate advertisement is often more convincing that a whole page of automobile copy. Co-operative newspaper advertising is most effective, and this is a practical matter that can well be brought before local electrical organizations such as Electrical Clubs, and Leagues, Luncheon Clubs, Jovian Clubs, etc.

(2) Your copy—the value of your ad. depends upon what you say, and how, and not on how much. "Know what you want to say, say it and stop," is the advice of a prominent advertising expert. Let the prospect get your story at a glance.

(3) Your windows—don't let them get the loafing habit. Your window is one-half to three-quarters of your store's publicity value. Don't waste it for a single hour, but keep it working. A professional departmental store trimmer's time may be had for a few dollars. Use motion—a bug creeping on a carpet attracts immediate attention. Apply the principle of motion to your window trim.

New Branch Offices

The Standard Underground Cable Company of Canada, Limited, have established new branch offices at Montreal, Quebec and Winnipeg, Manitoba, in order to facilitate the prompt handling of their growing business. The Montreal office will handle all business from the province of Quebec and the eastern part of the province of Ontario. This office is in charge of Mr. R. G. Harris, formerly connected with the general offices of the Standard Underground Cable Co., Pittsburgh, Pa., but more recently with the New York sales office of that company. The Winnipeg office will handle all business coming from the provinces of Alberta, Saskatchewan, Manitoba and that portion of the province of Ontario lying west of Ft. William. Mr. B. S. Stewart has charge of this office. Mr. Stewart has spent some time in the general offices of the associate American company, Pittsburgh, Pa., later going to the Chicago sales office of that company where he has spent a number of years. Business originating in the province of British Columbia and in Alaska and Yukon Territories will be handled by the Seattle, Wash., office of the company, and business from the Maritime Provinces will be handled by the Boston, Mass., office. This is a temporary arrangement in order to secure prompt service for customers in those districts until the volume of business justifies establishing separate offices in the Dominion.

The general offices of the company at Hamilton, Ont., will handle all business from the central and northern portions of the province of Ontario. Mr. W. H Marsh, sales manager and secretary of the company, has direct charge of business coming into this office as well as general supervision of the various branch offices. The establishment of these branch sales offices puts the Standard Underground Cable Co., of Canada, Ltd., in an excellent position to handle with accuracy and despatch all business which they may secure. The men in charge of the various offices are salesmen of experience and ability, released by the associate U. S. company in order to strengthen the personnel of the Canadian company.

Condulets

We reproduce below the specifications followed in the galvanizing of the Crouse-Hinds condulets. The requirements and tests appear to be sufficiently severe to guarantee the customer against anything but thoroughly reliable material.

The fittings shall be thoroughly cleaned, pickled, and then electro-plated with a coating of zinc. This coating must adhere firmly without scaling or blistering, to every part of the casting. Any specimen must be capable of withstanding the following test:—a sample shall be immersed in a standard solution of copper sulphate for one minute,

and then removed and immediately given a thorough washing in water and wiped dry. This process shall then be repeated. If, after the fourth immersion, there should be a copper colored deposit on the sample or the zinc should have been removed, the lot from which the sample was taken shall be rejected. The standard solution of copper sulphate crystals has a specific gravity of 1.185 at 70° F. and during the test the temperature of the solution shall not be less than 60° F. nor more than 70° F. (Note.—The above test shall be taken as applying to the outside surfaces of the castings only. Any such copper deposits forming on the inside surfaces shall not be taken as evidences of failure to comply with the specifications). To prevent corrosion and insure a smooth interior surface, all fittings shall be thoroughly cleaned and pickled on the inside and finished with a heavy coat of insulating enamel.

Motor-operated Drills

A piece of apparatus which is winning its way very quickly into all kinds of factories, work shops, etc., is the motor-operated electric drill. One of the most satisfactory types is that manufactured by the Van Dorn & Dutton Company, the Canadian agency for which is held by Mr. A. Ross Oborne. The popularity of this particular type of drill is shown by the fact that between 400 and 500 of them have been sold in Canada during the past year, the purchasers including the names of most of the wood and metal working factories, bridge works, railway shops, piano works, and

electrical contractors. The electrical contractor has found this apparatus a very valuable adjunct in placing his wires where walls or floors or beams or any other obstruction has to be pierced. In this case the ordinary auger attached to the electric drive does the work quickly and neatly. During the last few days an order has been received from the Office Specialty Company requiring the supply of one drill to each of the ten branches of this company. Much of the success of this particular drill is due to the fact that it is made to stand hard service and that it is equipped with what is known as the "universal" motor, which means that it will operate on either direct or alternating current. The cut shown illustrates a demonstration of this apparatus recently made by the Aikenhead Hardware Company, Limited, in the display windows of the Toronto Hydro-electric System.

1913 Diaries

The Canadian Westinghouse Company, Limited, of Hamilton, Ont., have distributed their very useful diary, as is their usual custom with the New Year. This diary contains a very great amount of condensed and valuable information which the average engineer will find it worth while carrying around in his pocket. The cover design and the binding are even more attractive this year than usual.

The Siemens Company of Canada, Limited, are distributing a very handsome pocket diary for the year 1913 which also includes an insurance coupon. The diary is supplied with a neat pencil pocket and pencil and a handy marker on which the words "Siemens Brothers Dynamo Works" appear in gold.

New J.-M. Plant

The H. W. Johns-Manville Company have just completed their new plant at Manville, N.J. The new plant consists of nine buildings, which, together with their products, are classified as follows: A.—Textile and Packing. B.—Rubber Plant; Electrical Specialties and Printing Department. C.—Pipe Covering. D.—Paper Mill. E.—Magnesia. F.—Roofing. G.—Mastic and Waterproofing. H.—Roofing Coatings. I.—Power Plant and Pump House.

These buildings represent the most advanced ideas in fireproof construction, being of brick, steel and concrete, with roofs of J-M asbestos roofing. They are planned not only for safety but to afford the best operating conditions for the employees. The "daylight" form of construction which is empolyed throughout permits a flood of light to enter the buildings through large triple-unit windows placed close together. The walls, ceilings and uprights are coated with J-M fireproof cold water paint. Artificial illumination is provided in the form of J-M linolite lamps and Frink reflectors.

"Northern Light" Tungsten Lamps

The Northern Electric and Manufacturing Company, Limited, have recently introduced on the Canadian market a complete line of high efficiency incandescent lamps under the name of "Northern Light." These lamps are manufactured under Canadian patents and are made up on a very rigid specification. All possible means is taken to insure every lamp being of rated capacity, high efficiency and long life. The "Northern Light" lamps are made in all styles of standards and in continuous wire-drawn Mazda filaments, carbon filaments, and metallized carbon filaments. The company have issued an attractive price list covering these "Northern Light" lamps.

The McGill Catalogue

The McGill Manufacturing Company of Valparaiso, Ind., manufacturers of lamp guards, portables and other electric specialties, have issued a very handsome catalogue for 1913, covering their complete line. Included in the products of this company are the well-known Loxon lamp guards, the McGill protector and portable guards, star soldering paste, baby gasoline torch, crescent coloring fluid, adaptable lamp changer, automobile trouble finders, etc. Among articles listed for the first time are the Gripson lamp guard which is an electrically welded guard made with reflecting top and furnished with two styles of cone shaped shades; also two new portables, the Imperial and the Jumbo, a vapor proof water-tight portable for use in damp places. This catalogue will be of interest to every electrical jobber, dealer and contractor.

Change of Address

The Toronto office of the R. E. T. Pringle Co. are moving from their present quarters in the Continental Life Bldg. to 308-9-10 Tyrrell Building, King street east. The new

quarters will be occupied about the 1st of February. This branch will be in charge of Mr. A. Ross Oborne as formerly.

Industrial ABolites

The accompanying sketch shows the new steel ABolite recently brought out by the Adams Bagnall Electric Company of Cleveland. It is known as the diagonal ABolite and is made in two general types, one for deflecting the light

at an angle of 30 degrees, the other for a 45 degree deflection. This type is made in capacities from 25 to 500 watts varying in size from 7 in. to 16 in.

New Factory for Independent Electric

The Independent Electric Manufacturing Company, Milwaukee, Wisconsin, have completed a new factory and moved all their equipment and stock into the new quarters. The building is located on the south side of Milwaukee and is a most complete and up-to-date factory for the manufacture of starting and controlling devices. Before building the company spent considerable time in thoroughly investigating different modern manufacturing plants and have endeavored to build a shop combining many new features. The building is constructed of concrete and brick, both sides being fitted with a large number of steel frame windows giving ample light throughout the entire floor space. Special attention has been paid to the experimental and test rooms, the test room being equipped with motor-generator sets so that many variations of d.c. voltage may be obtained for testing d.c. apparatus. Transformers have been installed for the different alternating current voltages. Easements have been obtained from the railroad company for siding across the property and a switch track will be constructed to the shipping room door this coming spring. The property on which the factory is built is located on the Kinnickinnic river, making it possible to ship and receive by water as well as rail when necessary.

Kellogg Magnet Wire

The Kellogg Switchboard & Supply Company have just issued a series of novel advertising matter which includes also a quantity of valuable technical information. This company have made novel use of the fact that magnet wire is wound on spools and have printed their information in the form of twelve "Spools of Facts." These spools are printed on heavy stock in three colors to indicate the yellow wooden spool ends, glossy black of the enamel insulation and the green of the silk colored wire. Each spool is therefore an exact reproduction. In addition the Kellogg Company are distributing an attractive folder which describes the method of manufacture of good wire and calls attention to some of the finer points in its service which are not evident to the ordinary observer.

"Suggestions" for 1913

We are in receipt of the annual copy of "Suggestions" compiled by Mr. H. D. Bayne, special agent of the Canadian General Electric Co. Mr. Bayne has been particularly happy in his choice of eleven pithy resolutions. These are evidently for the last eleven months of the year, Mr. Bayne no doubt considering it unnecessary to add any more resolutions to the usual number we all make for January.

The Boston Office of The Cutler-Hammer Mfg. Co. moved from 176 Federal street to larger quarters in the new Columbian Life Building, the first of the new year.

Trade Publications

Binding Posts and Connectors—Bulletin No. 65, issued by the Kellogg Switchboard and Supply Company of Chicago, describing binding posts and connectors manufactured by this company.

High tension switches—Bulletin No. 100 issued by the Electrical Engineer's Equipment Co. of Chicago. This is an illustrated catalogue dealing with the various types of pole-top switches manufactured by this company.

Advertise—A booklet issued by the Kellogg Switchboard and Supply Company outlining the value of persistent advertising. This company has taken for its watch word "Advertise your Service and watch your lines grow."

Books for home study—The Norman W. Henley Publishing Co. have issued a catalogue of practical, scientific and technical works, each of which they claim is written by an expert and yet uses such simple language that the subject matter is easily understood.

C. G. E. Equipment.—The Canadian General Electric Co. have issued pamphlet No. 506 on "Ozonators," an equipment designed to improve the hygienic conditions wherever indoor air is breathed; power consumption approximately 70 watts. The same company have issued a small sheet describing "Hubbell Receptacles" and another describing "Hubbell Shade Holders."

Ornamental Lighting.—Catalogue issued by the Electric Railway Equipment Company, Cincinnati, illustrating and describing 1, 3 and 5-light ornamental lamp standards; combination railway and lighting poles; lighting fixtures arranged for Mazda lamps; brackets for supporting ornamental luminous arc lamps, etc. This is a very attractive catalogue, the illustrations covering the field very fully.

Westinghouse—The Westinghouse Electric & Manufacturing Company have just issued leaflet No. 3511 describing and illustrating box-frame commutating pole railway motors Nos. 317, 317-A, and 317 A-2. These motors are adapted for high speed interurban service and the A2 type is for use with field control; also folder 4245 describing the mechanism in detail and illustrating the working parts of the Universal blow torch; also a little folder entitled "Saving the Tires without Fire," which folder describes the automatic tire vulcanizer manufactured by this company.

Pneumatic Tools.—The Chicago Pneumatic Tool Company have issued a number of bulletins describing the Duntley electric and portable tools, a complete line of which they manufacture. These publications include bulletin E.22, describing heavy duty electric drills for alternating current; bulletin E.26, describing universal electric drills operating on direct or alternating current; bulletin E.27, describing heavy duty electric drills for direct current. The same company have also issued bulletin No. 34G, describing their air receivers, aftercoolers, air line drain traps, reheaters and economizers.

Current News and Notes

Bothwell, Ont.

The Florence Power, Light and Milling Company, Limited, has been incorporated with a capital of $5,000 for the purpose of developing, producing, generating and transmitting electric power with head office at Florence.

Calgary, Alta.

The contract of the Calgary Power Company with the city of Calgary has expired. The rate was $30 per year per horse power. Pending a renewal of the contract the old rate is being continued.

Contract has been awarded to the Ottawa Car Co. for 12 41-ft. 6 in. car bodies; 12 46-ft. 6 in. car bodies, and 6 44-ft. 6 in. trailers; also for 30 set Brill, 22 G1 trucks; also to Canadian Westinghouse Co. for 24 complete quadruple motor equipments, 24 complete air-brake equipments.

The citizens passed a by-law authorizing the street railway extensions. A vote was also taken on a by-law to grant certain rights to the Alberta Interurban Railway Company. This was defeated, however, on the ground that the agreement was not sufficiently explicit in its terms, and allowed the company, among other things, the privilege of operating its lines through central streets of the city by steam, if it desired to do so.

Cambie, B.C.

The Richmond council has unanimously decided to take over the Farmers' Telephone system.

Fort William, Ont.

$40,000 was voted for the extension of the municipally owned street railway system.

Guelph, Ont.

The rates of both light and gas have been placed on a different basis with the New Year. Gas has been reduced 5c per thousand cubic feet, and now stands at 75c, 80c and 85c, depending on the quantity used. Instead of a straight 8c rate for lighting, the floor area method is being inaugurated which in some cases will also mean a reduction.

Galt, Ont.

The 1912 report of the Hydro-electric Department of the municipality of Galt states that the manner in which the power load is increasing is perhaps the most gratifying feature of the whole system as a big power load is the best guarantee of cheaper rates. Starting with a connected load of 25 h.p. this has been increased to a connected load of 750 h.p. with prospects of immediate further increases. This does not take into account the Waterworks Department or the Grand Valley Railway.

Humboldt, Sask.

Contract for engines and boilers let to E. Leonard & Sons, and for electric equipment let to C. G. E. Chipman & Power engineers.

Hamilton, Ont.

Barton Township has made application to the city for an extension of the hydro-electric system to this section.

London, Ont.

The people did not vote on the Sunday car by-law.

It is likely a by-law will be prepared asking citizens to expend $1,000,000 on electrifying the London & Port Stanley Railway.

The gross earnings for the year 1912 of the London Street Railway Company are said to show an increase of ten per cent over 1911.

The composition of the new city council indicates that Mr. Beck's scheme for the electrification of the London and Lake Erie Railway can be carried through.

Lansing, Ont.

It is reported the Toronto and York Radial Railway Co. will build a spur line connecting this place with Markham.

New Glasgow, N.S.

It is reported the electric line is being extended next year into the southern part of the town.

New Westminster, B.C.

The B. C. Electric Ry. Co. have submitted plans to city council for approval, of railway yards to cost $200,000.

It is reported that the city council has entered into a new contract with the B. C. E. R. Co. for eleven years for the supply of power at 1¼c per kw. hour. The former rate was 1.16c.

New Waterford, N.S.

The Dominion Coal Co., Glace Bay, are asking estimates for equipment for colliery plant of capacity of 20,000 kilowatts.

Ottawa, Ont.

By-law passed authorizing the Morrisburg and Ottawa Electric Railway Company to construct its railway, and to operate the same by electricity or by gas and electricity, within the city of Ottawa to a terminal point named in the by-law.

Parry Sound, Ont.

Ratepayers passed by-law Jan. 6th to extend electric lighting system.

Prince Albert, Sask.

Tenders will soon be called for hydro-electric penstock, canal excavations, tailrace excavations and concrete work; plant to develop 15,000 h.p. at La Colle Falls. C. H. & P. H. Mitchell, engineers.

Richmond Hill, Ont.

The electric light supplied by the Toronto & York Radial Railway Company was turned on along the main street for the first time on December 30th. It is reported that very satisfactory comments were made on the result of the new installation.

The by-law ratifying the agreement with the Toronto and York Radial Railway Co. for the supply of power to this town, carried by a very large majority.

St. Marys, Ont.

The superintendent has been instructed to prepare estimates for extending power lines, also to get figures on recording instruments for keeping a check on the peak load.

Sarnia, Ont.

Tenders will be called shortly for a large number of additional electric lights.

Sydney, N.S.

Maritime Telegraph & Telephone Co., Ltd., head office Halifax, N.S., contemplate installing switchboard in North Sydney & Sydney Mines Exchanges in the spring.

The Maritime Telegraph & Telephone Co., Ltd., contemplate improving whole system east of Halifax, also making several extensions.

St. Thomas, Ont.

The London and Port Stanley Electric Railway is now being operated entirely by power supplied by the Hydro-electric Power Commission of Ontario.

Stratford, Ont.

The by-law granting a 25-year franchise to the Sir William MacKenzie interests was carried by a large majority.

St. John, N.B.

The number of telephones in use in this city is now 5,000, an increase of 700 during the last year.

Saskatoon, Sask.

By-laws totalling three quarters of a million are being submitted to the electors early in the year. This includes an expenditure of $175,000 on electric light extensions.

The question is again being considered whether the city shall return to its original custom of conducting a department for the sale of electrical supplies.

Toronto, Ont.

Every hydro-electric by-law submitted in Ontario was carried by a very large majority. The by-laws, which were either to authorize the expenditure of certain sums of money or to enable the council to negotiate with the Commission, included the following places: Goderich, Clinton, Sarnia, Peterboro, North Bay, Uxbridge, Stouffville, Markham, Cannington, Beaverton, Winchester, Rockwood, Stayner, Exeter, Elmira.

The civic car lines on Gerrard street will be operated on Sunday.

Preliminary reports made public by the Hydro-electric Power Commission indicate that the cost to date of the distribution system for serving the municipalities is $4,158,829. That is made up as follows:

Right of way		$ 542,088.85
Transmission lines—		
Steel tower lines	$1,537,977.72	
Wood pole lines	493,037.99	
Telephone lines	129,668.95	
Relay system	54,537.32	
Conduit and cable system	40,907.88	
		$2,256,129.86
Transformer stations		1,322,806.73
Distributing stations		57,803.80
Total		$4,158,829.24

Vernon, B.C.

The Elec. Ltg. Commission have recommended purchase of [illegible] supplies for light extensions.

Winnipeg, Man.

Chapman & Walker, 305 McGreevy Blk., have been awarded contract for transformer equipment for 17 pump houses.

Condensed Department

RATE

Positions Wanted
Positions Vacant
Miscellaneous.
} 2 cents a word per insertion.

Tender advertisements, equipment for sale, etc., 15 cents per agate line (14 agate lines make one inch) per insertion.

Advertisers who wish to conceal their identity may do so by using an Electrical News box number without extra charge.

Forms close on the 18th of each month.

CITY OF MOOSE JAW
SASKATCHEWAN

Tenders for Electrical Machinery

Sealed tenders marked "Tenders for turbo-generator" will be received by the City Commissioners, Moose Jaw, Sask., up to 12 o'clock noon on **Monday, February 10th, 1913**, for the manufacture, supply, delivery and erection of one 1,500 kw. steam turbine and generator.

Specifications and general conditions may be obtained upon application to J. D. Peters, Electrical Superintendent, Moose Jaw; The Commercial Intelligence Branch, Board of Trade, 73 Basinhall street or London Chamber of Commerce, London, England.

The lowest or any tender not necessarily accepted.

A. W. MAYBERY,
L. W. RUNDLETT, Commissioners.
W. F. HEAL,

2

Situations Vacant

Draughtsman First-class, experienced in Switch Gear for High Tension and Low Tension A.C. work for large Hydro-Electric Plant in Canada. Must be neat, accurate, capable and able to do designing and layout work under supervision. Also Junior on similar work. Apply to Toronto Power Company, Niagara Falls, Ont., Canada. 1-2

WANTED Electrical travelling salesman, technical graduate preferred. Good opening for man who is efficient and who has ability. Write, giving age, experience, etc., to Box 680, Electrical News, Toronto, Ont. 2-2

Draughtsman wanted, by Toronto Hydro-electric System, experienced on High and Low Tension, Sub-station Design. Good salary. Apply Station Department, 228 Yonge Street, Toronto. F

Situations Wanted

Electrical Engineer, McGill graduate, seven years' experience with steam, hydraulic and internal combustion generating plants, operation and construction, wishes position as superintendent of power system or with consulting firm. Will go anywhere but prefer British Columbia. Salary $2,000 per annum. Reply Box 666, Electrical News, Toronto, Ont. 1-3

Position wanted by Electrician as operator in power house or would like to manage same. Familiar with A.C. and D.C. currents. Age 22. Single. Western town preferred. Box 677, Electrical News, Toronto, Ont. 2

Electrical Superintendent or Foreman
Man of executive ability and technical training, would like a change to position with good prospects. Thirteen years' experience in construction and maintenance. Best references. Box 421, Electrical News, Montreal. 1

Position as Hydro-electric Power House Superintendent of small plant or assistant in larger plant. Ten years practical experience in care, maintenance and operation of power house and sub-station apparatus. Good technical education. Associate A. I. E. E. Best references. Box 659, Electrical News, Toronto, Ont.

Electrician open for engagement- experience in wiring, operating and repair work. Best references; age 26. Apply Box 670, Electrical News, Toronto, Ont. F

Patent Act

Take notice that the undersigned are prepared to supply at a reasonable price the furnace for steam boilers described in Canadian Patent No. 109,928, January 28th, 1908, or to grant anyone a license to have the same manufactured for him at a manufacturing establishment in the Dominion of Canada. They are also prepared to receive offers for the purchase of the patent or for licenses to manufacture under the same. Ridout & Maybee, 59 Yonge Street, Toronto, attorneys for Henry Schofield. 1

Car Ventilating Systems

The Vacuum Car Ventilating Company has commenced manufacturing Mechanical Car Ventilating Systems under Canadian Patent No. 128070, dated September 13, 1910, and is prepared to furnish same on demand. For detailed information and prices, address Lock Box No. 25, Windsor, Ont. 10-t.f.

Notice

The undersigned, attorneys for the patentee, are prepared to grant licenses, at a reasonable price, to all desiring to use the method of producing electric oscillations described in Canadian letters patent No. 119,908, issued on the 10th day of August, 1909, to R. C. Galletti. Ridout & Maybee, 59 Yonge Street Toronto. 1

CITY OF REGINA, SASK.
REGINA MUNICIPAL RAILWAY.
TENDERS
FOR
TRACK and TROLLEY MATERIAL

Sealed tenders registered, and clearly marked on the outside of the envelope "Tenders for the Supply of Street Railway Materials," and addressed to the City Commissioners, Regina, Sask. Canada, will be received up to noon **Monday, the 24th day of February, 1913**, for the supply of:

CONTRACT D.

1100 long tons street railway steel 7-in. Tee rails, Lorain section 80 335.
1550 pairs 6-hole 26-in. splice bars for Lorain rail section 80/335.
1040 long tons street railway Tee rails, 60 lb. A.S.C.E. section.
2000 pairs 4-hole 24-in. angle bars for 60 lb. A.S.C.E. steel rails.
10000 track bolts and nuts, 3½-in. x 1-in., oval heads, hexagon nuts.
9000 track bolts and nuts, 3¼-in. x ¾-in., oval heads, hexagon nuts.
10000 split lock nut washers for 1-in. track bolts.
10000 split lock nut washers for ¾-in. track bolts.
650 kegs (each keg 200 lbs.) standard railroad spikes, 5½ in. x 9 16-in.

CONTRACT E.

5400 4 0 standard copper rail bonds, 10⅞-in. C.C.
3600 4/0 standard copper rail bonds, 13-in. C.C.
630 4 0 solid copper rail bonds, 62-in. C.C.
60 4 0 solid copper rail bonds, 72-in. C.C.

CONTRACT F.

10000 standard sawn square B.C. fir railroad ties, 6-in. x 8-in. x 7 ft.
35000 standard sawn square B.C. fir railroad ties 6-in. x 8-in. x 8 ft.
1250 Western cedar poles, 30 ft. long, 7-in. top.

CONTRACT G.

20000 barrels Portland Cement.

CONTRACT H.

21 miles 2 0 hard drawn trolley wire.
12 miles 4 0 D.B.W.P. 19 stranded copper wire.
4 miles 2 0 D.B.W.P. 7 stranded copper wire.
10 miles 3 8-in. stranded soft drawn iron wire.

CONTRACT J.

Insulators, Hangers, Brackets, Pullovers, Turnbuckles, Trolley Frogs, Crossovers, Clinch Ears, Pole Line Hardware, etc., etc.
All material to be delivered F.O.B. Regina, Freight and duty PAID.

Copies of specifications, schedules, delivery dates, and form of contract, and other particulars can be had upon application to H. Doughty, Superintendent, the Regina Municipal Railway, Regina, Sask., Canada.

Persons tendering are notified that tenders will not be considered unless made on forms supplied. Forms will be mailed upon request to the Superintendent.

A marked cheque covering five per cent. (5 p.c.) of the amount of the bid (made payable to the City Treasurer) must accompany each tender.

The City Commissioners reserve the right to reject any or all tenders.

R. MARTIN, Mayor.
G. A. MANTLE,
L. A. THORNTON,
City Commissioners.

Electrical News

Generation, Transmission and Application of Electricity

PUBLISHED SEMI-MONTHLY BY

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Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 22 Toronto, February 1, 1913 No. 3

Underwriters' Requirements

On another page in this issue we print a report recently made by Mr. C. Hamilton Wickes to the British Board of Trade on the formation, scope of operations and effect on the importation of British manufactures into Canada, of the Underwriters' Laboratories, Chicago. The report coversfully the history of the formation of this incorporation; describes the technical staff, the council and their respective work; outlines specifications, rules and requirements under which the experimental work is carried on at the laboratories; speaks of the inspection at manufacturers' factories and labelling; roughly outlines the cost of experiments and tests incurred by manufacturers who desire to have their material approved, etc., etc. Inasmuch as this is a matter of interest to every Canadian buying or selling electrical equipment, many of whom we believe are not aware of the existent conditions, we print this part of the article in full, believing that it contains much useful information.

However, the part of the report which is of greatest interest to Canadians is that which deals with the effect of the operations of the Underwriters' Laboratories on the British manufacturer. It has long been recognized in a general way that British manufacturers were more or less inconvenienced by having to conform to the rules and requirements laid down by the National Board of Fire Underwriters, but in the report in question, some statements are made which appear to require further investigation. For example, in one place it is stated that complaints have been made by British manufacturers of prejudice on the part of inspectors against British goods and of the necessity of gaining the inspectors' good-will by means of a "tip" in order to facilitate the passing of material submitted. In another case it is stated that particulars are on file, of instances in which the parties interested alleged discrimination and unfair treatment in respect of both electrical and other classes of goods submitted to the laboratories. If such complaints as the above can be substantiated, it is quite time steps were taken to show up the workings of the Underwriters' Laboratories in their true light. Of course, it is easily understood that these are matters difficult of proof. There is no doubt, however, that the feeling exists that discriminations have been shown, and under the circumstances it is not difficult to impute motive. On the other hand, we are decidedly of the opinion that the work of the Underwriters' Laboratories has, in the main, tended to improve conditions and has gone far towards making the installation of undesirable equipment impossible.

* * *

A phase of the question that is no doubt felt keenly by the British manufacturer, and this applies to Canadians as well, is the fact that a British manufacturer who has been manufacturing standard equipment for many decades and whose products are known and recognized as standard the world over, should have to submit his apparatus to the inspection of a United States authority before this apparatus can be sold in a part of the British Empire—Canada. Then there is the other reasonable contention that inasmuch as the inspectors are specially equipped to pass on the United States type of material they are not in a position to give an immediate and final judgment on the efficiency of a British manufactured article. Further, it may easily happen that though the British article may be entirely up to any general standard that may be set, it may fail to meet the requirements of the particular standard of the Chicago Laboratories and so may fail of approval.

* * *

A suggested solution is the formation of a testing and approving laboratory in England or Canada along lines very similar to that in the United States. It does seem unreasonable that a nation as widely represented by territory as Britain is should not have a standard of her own which would be accepted without question, in any colony of the Empire, or for that matter in any other country. There can be no doubt that the British manufactured article reaches as high a standard as anything manufactured in the world to-day, and the whole trouble evidently arises from the fact that in the United States they have taken the initiative in this matter while the Englishman did not feel the need of the same progressive step until he came in direct contact with the United States product on this continent. The British manufacturer at the present time is trying hard to win his way into the North American, and especially the Canadian field, and every Canadian is anxious to assist him in every possible way to gain a foot-hold, feeling that by so doing, we shall gain the advantage of the competition of apparatus that it will be to our interests to purchase. We therefore, as Canadians, have put ourselves about to no small extent in encouraging the British manufacturer to tender for the supply of our equipment. It would now seem to be a great mistake if all this progress should have to be set aside, or should even be retarded by what is little more than a technicality. It is quite possible there are British manufacturers who have abandoned the idea of entering the Canadian field rather than submit their equipment to the tests now required. The formation of a British standard, recognized the world over, should mean nothing more than the organization of a department along these lines similar to that of the Underwriters' Laboratories of Chicago. Where it is situated is a matter to no moment so long as it is at the most convenient point for all concerned.

The New Hydro Chief

"School" men will be pleased to note that one of their number has been called to the high office of chief engineer of the Hydro-electric Power Commission of Ontario, in the person of Mr. F. A. Gaby, who graduated, with honors, in the Faculty of Applied Science of the University of Toronto in 1903. Though only a recent graduate, Mr. Gaby has, however, crowded an unusual amount of hard work and experience into a short space of time, having spent a number of years with the C. G. E. company as erecting and supervising engineer, and later with the city of Winnipeg, where he acted as assistant electrical engineer in the preparation of the designs and specifications of their large municipal plant.

Mr. Gaby has been with the Hydro since 1907, practically since its inception. In 1908 he was appointed chief assistant engineer which position he held until Mr. Sothman's resignation in July, 1912. As chief assistant, Mr. Gaby had, of

Mr. F. A. Gaby

course, been closely in touch with all the engineering features of the Hydro scheme, and so both by ability and experience was particularly well fitted to take up the work of directing the Commission's extensions, which probably at the present moment cover a larger field than at any previous time in the history of this provincial municipal movement. His appointment as acting chief engineer in July, was, therefore, fully expected, and the confirmation of his appointment, in December, as chief engineer, will meet with universal approval.

Mr. Gaby is almost a Toronto boy, having been born in Richmond Hill, some thirty miles out of the city. He is an associate of both the I. E. E. and A. I. E. E., and is at present chairman of the Toronto section of the latter.

Toronto Section A. I. E. E.

The third regular monthly meeting of the Toronto section of the American Institute of Electrical Engineers was held in the Engineers' Club rooms Friday evening, January 17th. The speakers of the evening were Mr. W. R. Sweany, general manager, the Toronto Hydro-electric System, and Mr. J. G. Jackson, electrical engineer. Mr. Sweany described the advances that had been made in the production of an economic up-to-date street lighting system, comparing the Toronto system with that of a number of other cities. Mr. Jackson dealt more with the engineering side of the system, describing the distribution, location of sub-stations and sub-station design, etc. Mr. Jackson also outlined plans of extensive expansions which the city would likely follow as the demand for power and light increased.

Merger of Power Companies at Cobalt

The Northern Ontario Light and Power Company, Limited, has formally taken over the entire property and assets of the British Canadian Power Company, Limited. The property has been paid for by $2,000,000 first mortgage 6 per cent. Bonds of the Northern Ontario Light and Power Company, Limited, which are due on April 1st, 1931. This is a part of an authorized issue of $15,000,000.

The Bonds, it is understood, have been underwritten by Coates, Son and Company and the British Electric Traction Company, both of London, England, and Hanson Bros., of Montreal. At a near date the issue will be offered for public subscription, probably at par.

It is calculated that the earnings of the Northern Ontario Light and Power Company, will be greatly benefited by the acquisition.

The Northern Ontario Light and Power Company was organized in February, 1911, for the purpose of taking over the properties of the Cobalt Hydraulic Power Company and the Cobalt Power Company, with its subsidiary companies. It has also acquired the Cobalt Light Power and Water Company, Limited.

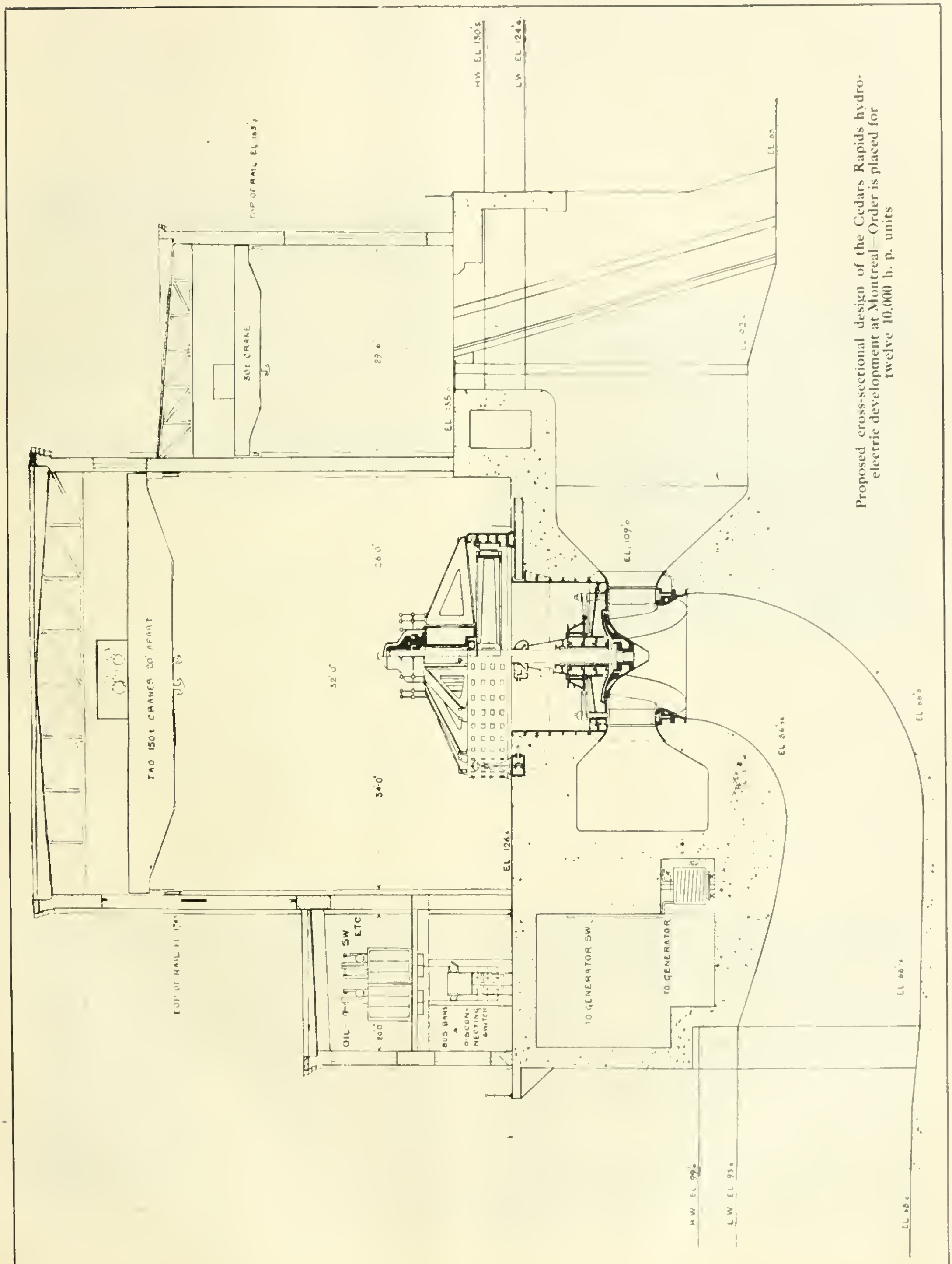
The British Canadian Power Company have a 10,000 horse-power hydro-electric development on the Matabitchonan River, 25 miles south of Cobalt with an electrical sub-station at South Lorrain and two modern sub-stations in the Cobalt camp, each equipped with step down transformer outfits and 2,000 horse-power air compressor plants. Compressed air at 100 lbs. pressure is furnished from these stations, through steel pipes, to the different mines. Electrical power is furnished from the three sub-stations to the mines in the form of a 60 cycle, 2,200 volt, 3-phase current.

The "Cedars" Development Plans

On the opposite page we reproduce the plan of the development of the Cedars Rapids Manufacturing & Power Company at Montreal. This represents the largest single installation, we believe, ever contracted for at one time in Canada, and with the exception of the plant at present under construction at Keokuk on the Mississippi River, probably the largest in the world. Orders have been placed for the manufacture of twelve turbine units, and within the last few days the contract has been closed with the Canadian General Electric Company for the supply of the twelve generators to be connected thereto.

The size of the equipment can be gathered roughly from the illustration. The overall diameter of the generators is approximately 36 feet. The capacity of each is 10,000 kilowatts. The generators, on account of the comparatively low head of 30 feet will revolve slowly, at 56 revolutions per minute.

It will be noticed from the design that the thrust-bearing carrying the weight of the generator-rotor, the shaft and the turbine, is situated above the generator and enclosed in the same case with the generator.

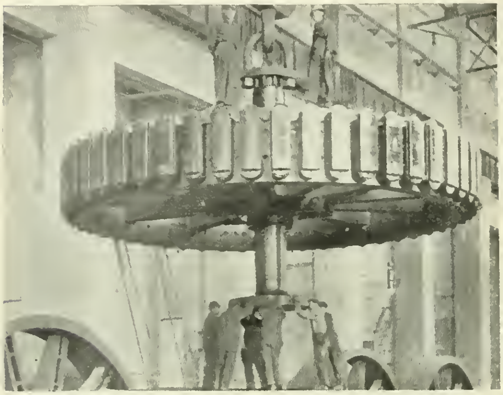


Proposed cross-sectional design of the Cedars Rapids hydro-electric development at Montreal—Order is placed for twelve 10,000 h. p. units

Further Notes on Keokuk Plant

The September issue of the Electrical News contained a somewhat detailed illustrated description of the preliminary work of the Mississippi River Power Company's development at Keokuk, Iowa. It will be remembered that the main plan of this development consisted in the construction of a dam 4,500 feet long, across the Mississippi River and comprising some 120 arches; a power house to contain thirty 10,000-h.p. turbine units; an ice fender some 1,750 feet long for the protection of the intake canals and a huge cement lock and dry dock for the accommodation of river traffic.

The previous description brought the construction up to June 1, 1912. Since that date the dam has been completed and the up-stream end of the power house is also practically finished with, at the last report, three units almost installed. Some more photographs shown herewith illustrate the more advanced stage of the work. One of the figures illustrates the process of setting the lower foundation ring for one of the water wheel units. Another shows a view taken some two months later, being an interior view of the intake for turbine No. 2.



Generator-rotor assembled—Mississippi River.

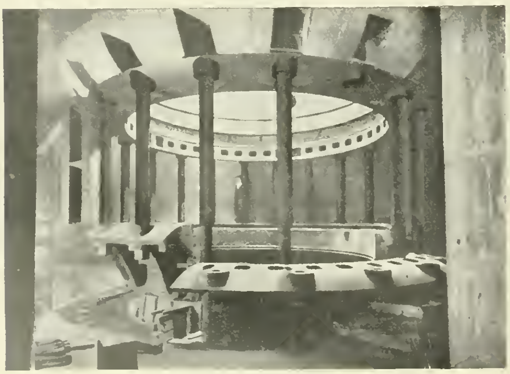
It will be recalled from the earlier description that pitt-liners of unusual size were to be embedded in the concrete of the substructure and that these were to carry the weight of the rotating parts of the turbine and generator, a total of about 1,000,000 lbs. of metal. Before placing the turbine, these were tested out by a load of approximately 1,000,000 lbs., made up of huge cement blocks, to see if there would be any settling. This was necessary as the shaft of the turbine would be thrown out of line if any settling occurred after the machinery was installed.

The shipping and installation of the turbines has required the greatest care on account of their weight and size. The contract for the manufacture of the turbines was divided between two firms. One firm casts the runner in four quarters which are shipped separately. The other manufacturer casts the runner in one piece. The difficulty of such a process will be understood when it is remembered that the complete runner is 16½ feet in diameter by 12 feet high and weighs about 65 tons. To transport this piece it was necessary to build a special car with a capacity of 150,000 lbs., and with a body so designed that the runner could lie on its side. A special route had also to be picked out in which the bridges were high and wide enough to clear this load. Each unit is accompanied by a representative of the manufacturing company, and is allowed to travel only during the day time, every care being taken to eliminate the possibility of accidents.

Turbine runner, assembled—Mississippi River.

The Generators

It will also be remembered that each generator when complete, will measure 31 ft. 5 in. in diameter by 11 ft. 3 in. high and weigh approximately 615,000 lbs. The base and



Setting lower foundation ring for turbine unit.

Interior view of turbine intake, completed.

the outside ring or stator are shipped in four pieces and the rotor in two. The windings of each part are shipped separately. For the stator these windings consist of rectangular coils of copper wire which fit into slots cut in the metal of the stator. These are insulated with mica and with oiled tape to resist the high voltage generated in them

In setting up the rotor the shaft is first set on end on a specially prepared concrete platform; next the two halves of the stator, supported at the proper height by concrete pillars, are bolted around it, and then 52 laminated iron poles with their copper windings are bolted on. At last reports, five of the stators have been wound, four of the rotors assembled, four bases are in place and one has its sections mounted on it.

Work is also proceeding with the installation of the transformers which will step up from the generating voltage of 11,000 to the transmission voltage of 110,000. Each transformer measures 8 ft. x 16 ft. x 24 ft. high and weighs approximately 246,000 lbs. The latest report was to the effect that the conduit work for conducting the lead wires was nearly all in place and that the superstructure should be practically completed by the first of the year.

Our Maritime Provinces

The Canadian Pacific Railway Company have equipped their terminal sheds at West St. John with four 2-ton electric trucks.

Mr. Robt. Bell, of Montreal, has recently been appointed general manager of the Maritime Coal, Railway & Power Company. This company operates a power plant at Chignecto, N.S., supplying light and power for the towns of Amherst, Joggins, Maccan and River Herbert. Mr. Bell was previously manager of the Port Hood Coal Company.

Mr. Thos. Coleman, until recently with Chapman & Walker, Toronto, has been appointed superintendent of the Charlottetown Light & Power Company of Prince Edward Island. This company are at present operating their plant with both steam and gas producer engines, the electrical equipment being single phase, 133 cycles. This year, however, they plan on remodelling the entire outfit and operating a day system, supplying power for the different town industries.

The Intercolonial Railway are planning on installing a system of train despatching by telephone; the first section to be installed will be between St. John and Moncton. The Intercolonial Railway are now using the Moncton Natural Gas very extensively at their shops in Moncton. At the present this gas is being used under their boilers and in the forges, and for lighting cars. Changes are also being made in their producer gas engines which drive the electric generators so that they too may be operated by natural gas.

The new power plant of the Bathurst Electric Light Company was put in operation January 1st and the town is now supplied with a first-class lighting system. The power house is situated at the Letagouche Falls, some nine miles from Bathurst, the transmission line at present being single phase at 6600 volts. A concrete dam 30 feet high has been constructed above the falls which, together with the natural falls, gives a head of seventy feet at the water wheel. The present capacity of the plant is 200 kw. but provision has been made for another unit of the same size. The complete plant was built under the supervision of P. J. Leger, of Bathurst

The Dominion Coal Company have recently put in operation their new power house at Lingan Lake, Nova Scotia Only one unit is at present in operation; this is a 2,000 kw Curtis high pressure steam turbine set, the generator being 3-phase, 25-cycle, 6,600 volt and arranged to work in parallel with the company's other power plant at Glace Bay, which is located about nine miles distant. Contracts have been entered into with Fraser Chalmers for two more units of the same size. Bettington boilers are used at this plant: these use pulverized coal, which is fed with a blower The power house is so arranged that a total of 10,000 horse power in turbines may be installed at a later date

The new canning factories of the Canadian Sardine Co at St. Andrews, N.B., began operation January 1. This is a most modern installation, every part of the process, from hoisting the fish from the boats to sealing the cans, being performed with electric motors. Besides canning sardines, baked beans, brown bread, fish cakes, and in fact all kinds of fish goods, will be prepared and canned on the premises Some idea of the size of the plant may be gained from the fact that some 35 motors of various sizes from 1 to 25 h.p are in use. A large box and shook factory is also being built; this will be operated with four 25 h.p motors, the machines being group driven. About one thousand lamps are needed for the lighting of the various buildings. These include a moving picture theatre and dance hall for the amusement of the company's employees who number at present about 800. The complete electrical and steam equipment was installed under the supervision of Mr. R. Kirwin, mechanical superintendent of the Sardine Company's plants.

Montreal a Centre of Activity

Members of the Electrical Association of the Province of Quebec held their annual dinner at Cooper's Restaurant, Montreal, on January 16th. The dining arrangements were excellent, the provision of a number of small tables allowing of the making up of congenial parties. Mr. Clarence Thomson presided, and among those present were: Ald. Boyd, Major Allan (of Verdun), Messrs. M. Rubenstein, J Bennett, L. Rosseau, E. W. Sayer, R. L. Calder, S. W. Smith (of Engineering Equipment & Supply Company), K. B. Thornton (Canadian Light & Power Company), C. A Howe (Holophane Company), R. J. Hiller, J. Garth, W. J. Doherty (Northern Electric & Manufacturing Company), A. Hall, N. Simoneau, F. J. Parsons, J. D. Lachapelle, W. N. Dietrich, Fred Thomson, and W. B. Shaw (Montreal Electric Company).

During the evening two presentations were made to Mr James Bennett, who is retiring from the position of chief inspector of the electrical department of the Canadian Fire Underwriters' Association. The first was of a humorous character, being in the form of a stand made of insulating material, with high tension insulators as shelves, which were filled with vegetables. This was presented by Messrs Rubenstein and Shaw, the former making some remarks in character with the presentation. The other presentation was of a clock and two cut glass decanters, Mr. Shaw making the presentation on behalf of the association Mr Bennett replied very briefly.

Letters of regret were read from a number of those unable to be present, including one from Mr Geo. C. Knott, of the Benjamin Electric, Toronto

Replying to the toast of "Our Cities and Province." Alderman Boyd, who represented the mayor, spoke of the natural and mineral resources of the province, and of the expansion of Montreal, making reference to the proposed

new building by-laws in which electricians were naturally interested.

Mr. C. E. McGregor proposed "Our Guests," to which Mr. Sayer, as representative of the Builders' Exchange, responded. He expressed a hope that the association would see its way to again become affiliated with the Exchange. Mr. Louis Burns, of Quebec, also replied.

"Manufacturers and Jobbers" was proposed by Mr. R. J. Hiller, and responded to by Mr. Doherty, who laid emphasis on the importance of manufacturers and jobbers sticking to their prices, and not cutting rates.

In proposing "Our Association," Mr. R. L. Calder referred to the enormous possibilities of electrical development in the Province of Quebec; the province should, he believed, be the centre of the electrical development of the world, as it could develop more power than all the rest of the world. A great many of our natural resources were being exploited by foreigners, but he had no doubt that the electrical industry would be controlled by Canadians and the people of Quebec. Mr. Sayer replied, and spoke of the success of the weekly luncheons and the mutual benefit which resulted from them.

Mr. Bennett, referring to his retirement, assured the members that, in issuing defect notices and criticising the work of contractors, he had tried to act impartially, and that no personal feelings had entered into his work. Mr. Fred Thomson declared that Mr. Bennett had filled a very difficult position exceedingly well, and had acted without bias to any contractors. Mr. C. M. Tait, as the successor of Mr. Bennett, also briefly spoke on inspection work.

Montreal Tramways Company

The Montreal Tramways Company have taken exception to the jurisdiction of the Quebec Public Utilities Commission in relation to an inquiry proposed to be made into the affairs of the company. The Commission asked for information as to various operations, chiefly in connection with accommodation, routes, lines, etc., and as this was not forthcoming the company were asked to show cause for failure to comply with the orders of the Commission. At the sitting of the Commission, the company objected that the orders were ultra vires, and declared that previous orders had only been complied with in order to avoid friction. Mr. J. L. Perron, the company's advocate, stated that at one time the company were willing to facilitate the investigation as a means to improving their relations with the city, but the attempt of the Commission to dragoon the company and the campaign of a Montreal paper had influenced the company in making objections.

The Commission decided to hear special arguments on the issue raised, and on Friday, January 17, Mr. Perron put the case for the company before the Commissioners. In brief it was that the contracts between the company and the municipalities covered all points which might arise, and that this, together with lack of specific authority on the part of the Commission, showed that the latter had no jurisdiction. Judgment will be given later.

In connection with the company's relations to the city of Montreal, the Board of Control have intimated to Mr. Robert, the president, that they cannot take up the question of the company carrying freight unless it be included in the discussion of a new contract for the entire service. The Controllers complain that they cannot get the company to seriously discuss the matter of a new contract, and that it is put off from time to time.

The repeated attacks on the Montreal Tramways Company, for alleged defective service, has resulted in a statement from the directors. In reply to criticisms that insufficient money was being spent to meet the needs of the increasing population, the auditor states that the company spent for new equipment, betterments and improvements from 1908 to 1911, annual amounts ranging from $729,368 to $871,193, while for the eleven months of last year $1,238,-240 was expended. All these amounts included the money spent on subsidiaries as well as on the main undertaking. The following statement shows the new cars scrapped and added during the past five years:

	Cars	Seating capacity
Cars added since January 1st, 1911 ...	140	5,667
Cars scrapped since January 1st, 1911 ..	34½	1,175
Balance added in two years	105½	4,492
Average per year	52	2,246
Cars added in five years	177	7,223
Scrapped during same period	57½	1,937
Balance added	119½	5,286
Average per year	24	1,057

Two hundred and ten of the latest p.a.y.e. type of steel cars, with a seating capacity of forty per car, are on order, and these are to be delivered at the earliest possible moment. While the company are providing an additional seating capacity of thirty-five per cent. the population of Montreal is only growing at the rate of 10 or 15 per cent. per annum.

The Sons of Jove

There was a particularly merry gathering of the Sons of Jove at a joviation and rejuvenation held at the Windsor Hotel, Montreal, on the night of January 20. Nearly one hundred were initiated, and the proceedings were of a decidedly lively character. The candidates were escorted in Indian file through the corridors of the hotel by members of the Order, the procession being headed by a banner bearing the announcement: "These are Jovians." The members of the degree team comprised the following: Messrs. F. J. Watts, Jupiter; R. J. Hiller, Neptune; T. H. Bibber, Pluto; D. H. Ross, Vulcan; F. W. King, Hercules; F. J. Parsons, Apollo; E. W. Sayer, Avrenim; A. D. Smith, Mars; and A. H. Davies, P. S. Ferguson, W. E. Marvin, and L. A. Johnston, imps. Mr. James Bennett presided at the banquet and the subsequent initiation of candidates.

C. G. E. Equipment

The St. Lawrence Bridge Company have contracted to purchase from the Canadian General Electric Company a large quantity of machinery to be used in the construction of the superstructure of the new Quebec bridge. The equipment includes six 250 kw. transformers, six 40 kv.a. transformers, four 250 kw. motor-generator sets, and a quantity of high and low tension switching apparatus. The motor-generator sets will be used for supplying direct current to the crane and hoist motors, while part of the transformer capacity will be utilized for power for the air compressors. Work on the bridge will begin at both ends, and the plant will be divided in order to facilitate this order of work.

Northern Electric Notes

Messrs. Pike, Doherty and Newton spent the Christmas week in the United States.

Mr. W. E. Leigh, foreign sales manager of the Western Electric Company, was a recent visitor at headquarters.

We regret to have to announce the death of Mr. Alex. Farrell, long connected with the engineering department of this company.

The annual sales managers conference which was held at Montreal during the week of January 20th was a success in every sense of the word, and terminated with a dinner on Friday, the 24th.

Miscellaneous

The Montreal controllers have voted $9,088 for 175 new arc lamps which are mainly for new wards of the city. This will make a total of 300 new lamps in two years. The distribution of the lamps is left to the discretion of Mr. Parent, superintendent of the lighting department. The total amount voted for street lighting for the season is $230,000.

It is understood that it has been decided to offer $8,000,000 bonds at 90 with 25 per cent. bonus of common stock, shareholders in the Montreal Light, Heat & Power Company and in the Shawinigan Water & Power Company being given the opportunity to subscribe to the issue in the proportion of 30 per cent. of their holdings of Power and Shawinigan.

The Montreal Tramways Company are adding to their equipment at the Central Station, William street, a 2,000 kv.a. synchronous motor, with a 1,500 kw., 600 volt direct connected generator. The Canadian Westinghouse Company will supply the machines. The Tramways company will also install a 15-ton mono-rail hoist, supplied by John Millen & Son, Limited, Montreal, for handling the machinery and for repair work.

The dividend of the Kaministiquia Power Company has been raised from four to five per cent. The number of directors has been reduced to six, and Mr. J. S. Norris, general manager and secretary-treasurer of the Montreal Light, Heat & Power Company, and assistant secretary and treasurer of the Kaministiquia company, elected a director. At the annual meeting, Mr. H. S. Holt was re-elected president of the company, with Mr. C. R. Hosmer vice-president. The general superintendent and secretary of the company is Mr. W. L. Bird.

February 1st has been fixed as the date on which the new Bell telephone rates come into operation in Greater Montreal. By order of the Railway Commission, the flat rate of $55 and $35 for business and residence telephones respectively, will be extended to the territory north of the St. Lawrence within a radius of six miles from the main exchange in Montreal, which, it is estimated, will mean that the increase in the zone will be equal to one-fourth of the old area. Beyond that zone mileage may be charged only on the portion of the subscribers' line located beyond the flat zone area.

The Montreal Council have voted $25,000 for the continuance of the work on plans for laying all cables underground. The plans for St. Catherine street are practically complete, and tenders will be called for the laying of conduits during February. The surveying of Bleury street and part of Park Avenue is done, and the surveying of nearly all Dorchester street completed. Work has also been commenced on the surveying of Sherbrooke street. Thus the surveying of the main thoroughfares in the west portion of the city is in hand.

At the annual meeting of the Montreal Telegraph Company, it was announced that out of the revenue (8 per cent guaranteed on the company's capital) derived from the operation of the company's property by the Great North Western Telegraph Company, $160,000 were paid out in dividends in the past year. From the revenue derived from the investment of the company's contingent fund, the eleventh annual bonus, amounting to $5,000, was distributed among shareholders, making the total distribution to the shareholders for the year $165,000.

Canada's Prairie Provinces

The demand for electrical power in Western Canada is increasing at a remarkable rate, and will do so for several years to come. Towns and cities are filling up with greater populations, commercial industries are coming in, and every year enlarging their capacities and extending their plants, to keep pace with the wants of the growing West. This demand is supplied to a great extent by the hydro-electric power companies, wherever water power is available.

The Calgary Power Company duly recognized this growing demand for power in deciding to increase the output capacity of their present generating station situated at the Horseshoe Falls on the Bow River, and to erect a new hydro-electric plant at the Kananaskis Falls two miles above the Horseshoe Falls. Both of these extensions are already under way and are to be rushed to completion with all possible speed.

Horseshoe Falls Power House.

The present capacity of No. 1 plant at Horseshoe Falls is about 12,000 horse-power, which supplies power to the city of Calgary and to the Canada Cement Company, at Exshaw. Electricity is generated at 12,000 volts and for the city of Calgary is stepped up to 55,000 volts and transmitted over a double pole line, a distance of about 60 miles. To Exshaw power is transmitted at 12,000 volts over a two circuit pole line a distance of nearly 8 miles.

Extensions to No. 1 plant will consist of a 6,000 h.p. turbine, supplied by the Wellman-Seaver-Morgan Company, of Cleveland, Ohio, controlled by Lombard governors, and a 4,500 kv.a., 12,000 volt, 3-phase, 60 cycle generator supplied by the Canadian General Electric Company. Two extra 3,000 kv.a., 3-phase, Canadian Westinghouse transformers will also be installed and switching apparatus to accommodate the new capacity of the plant. The present generating station will then be capable of supplying approximately 18,000 horse-power.

New Dam at Kananaskis Falls.

Some features of the new development at Kananaskis Falls are worthy of note. Immediately above the falls the Kananaskis river empties into the Bow, and at once narrows to a deep gorge, the river bed and the almost vertical banks being mostly hard pan rock, providing a very suitable site and foundation for dam. Owing to the narrow gorge across which the dam will be constructed, the amount of material utilized and therefore the cost of construction will be moderate. The structure will be of reinforced concrete, the quantity of cement for the work being estimated at upwards of 24,000 cubic yards at a probable cost of eight dollars per yard. Provision will be made in the dam for two flumes leading to the turbines in the power house. Owing to the Kananaskis and Bow being mountain fed streams it is necessary that the building of the dam, etc., be mostly carried out at low water in the winter months.

The power house will be erected on the south bank of the river just below the dam, an estimated 7,000 cubic yards of cement being used in connection therewith. The hydraulic equipment will consist of two downward flow reaction turbines fed by two flumes from dam, and discharging into a tunnel leading to the lower level below the present falls. With this arrangement of dam and turbines an available head of seventy feet will be obtained. Turbines and generators will be of vertical type. The former will be supplied by the Allis-Chalmers-Bullock Company their gate openings and speed controlled by governors manufactured and installed by the same company.

Generating equipment will consist of two vertical shaft type, direct-connected generators, supplied by the Swedish

General Electric Company, 3,750 kv.a., 12,000 volts, 3-phase, 60 cycle giving a station capacity of 10,000 horse-power. The 12,000 volt busses will be direct connected to the Exshaw transmission line, thus eliminating step-up transformers. With this arrangement complete Exshaw or Calgary can be fed from either power house, the two stations being tied in together, giving the Calgary Power Company a most complete and efficient hydro-electric power system of 28,000 horse-power.

The total cost of construction and installation work is estimated at upwards of $1,500,000. The design and construction are being prosecuted by the company's own engineers; Mr. More is managing engineer for the company, Mr. H. S. Johnson, resident engineer, and Mr. Allen, construction engineer.

Fort Frances Telephone System

The council of the town of Fort Frances, in accordance with a largely signed petition, have decided to proceed with the installation of a new telephone system in the town. This system is to be under the control of the council, at least for the time being. We print herewith a copy of the specifications, which will doubtless prove of value to other towns similarly situated. The plans are on file at the office of the Clerk of the Town of Fort Frances, Mr. J. W. Walker.

The operating room will be located in the Town Hall and will consist of space for a switchboard. This room should be well ventilated and have an area of at least 120 square feet. The terminal room should be large enough to take care of line and cable racks, which will accommodate 500 metallic lines, and the necessary batteries and charging apparatus, including power ringing machine.

Switchboard.—The switchboard shall be of standard make and operate on central battery. It shall have 300 line capacity with 200 lines completely equipped and shall be so built, that it can be added to from time to time if necessary. It will be fully equipped with two operators positions. The line signals may be of either mechanical or a lamp signal type, operated from a central battery, either storage or dry cells. The switchboard shall have a capacity of 45 pairs of cords with 30 pairs installed, each pair of cord shall have double supervision, either mechanical or lamps. The board shall have an extra strip installed and wired to take care of twenty rural or toll lines, with ten lines completely equipped and installed. The cords for taking care of toll, trunk or rural lines will be equipped with repeating coils and necessary apparatus to connect with the lines of the common battery system. There shall be one line pilot signal for each operator's position for calling and disconnecting subscribers. These pilot signals may be of either the mechanical or lamp signal type. Each operator's position to be equipped with night bell and hand-power generator and switching key, also master key for four party, semi-selective ringing.

Terminal Room.—The terminal rack shall be of approved type and any of the following makes may be used:—American Electric Company, Frank B. Cook, or Northern Electric Company. The rack shall have an ultimate capacity of 500 lines, with 300 lines equipped on the terminal or line side and 250 on the protection side. The protection shall consist of carbon blocks and heat coils.

Storage Batteries.—If a full lamp signal type of switchboard is used, then storage batteries in connection with same shall be of approved type, governed by Bell Telephone Company, Limited, specifications. They shall have a capacity of 8 miles of standard cable and 500 telephones, the charging apparatus and ringing machine shall be governed by the same specifications and the required capacity.

Subscribers Telephones.—The telephone shall be for local and long distance talking, an approved standard pattern as adopted by Manitoba Government Telephones, Government Telephone Department of Saskatchewan, and shall conform with the Bell Telephone Company of Canada. The wiring of the subscribers houses, offices, etc., shall also be aproved by above standards. The telephone can be either Local Battery or C.B. talking.

Pole Line Construction.—All pole line construction shall follow the diagram as shown on the attached map. Any changes or alterations to be made only on the approval of the engineer in charge of the work. The material and work done shall be of standard construction, conforming to specifications of above-mentioned companies.

Brandon, Man.

It is understood that application is being made by the municipality of the city of Brandon to the Manitoba legislature for a charter to build and operate a radial railway covering a large area of land surrounding the city. The proposed electric railway will, it is claimed, connect all the small towns in the district, making Brandon the centre of a large system. It is calculated that much of the road can be constructed at a cost varying from $7,000 to $10 000 a mile. This cost will depend somewhat on the type of rolling stock adopted, a question which has scarcely been discussed as yet.

The contract has been closed with the Brandon Electric Light Company, Mr. G. A. Patterson, general manager, whereby the company agrees to supply power for the operation of the new municipal street railway system, which is practically completed in Brandon, at a rate of 2 cents per kw. hour. This contract is to hold good for two years at least, and at the end of four years the city has the option of purchasing the company's plant at its actual value as arrived at by arbitration. The Brandon Electric Light Company have both water and steam supply, and are one of the few companies operating in Canada who utilize their exhaust steam for heating purposes throughout the town.

Regina, Sask.

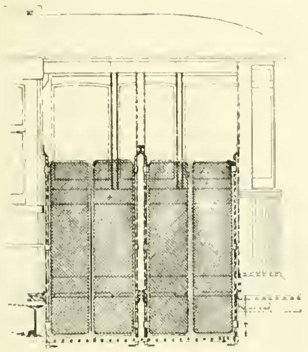
It is understood that the Regina-Moose Jaw Interurban Railway Company will be given powers of incorporation at the present session of the Saskatchewan legislature as the Private Bills Committee has reported the bill. This bill gives the company power to issue bonds at $12,500 a mile for a line of electric railway between the boundaries of Regina and Moose Jaw. Subject to the consent of the two municipalities concerned, running rights only may also be secured over the two city lines. Regina city is given power to expropriate any part of such lines as may subsequently fall within the city limits. A similar right is also conferred on the city of Moose Jaw if at any time it buys out the Moose Jaw Electric Railway Company. The same right however, of expropriation, is not granted the Moose Jaw Electric Railway Company.

Edmonton

The Siemens Company of Canada have received an order for a 5,000 k.v.a. 3-phase, 60 cycle, 1,800 r.p.m. turbo-generator for the city of Edmonton. This machine will be direct coupled to a Willans and Robinson turbine manufactured in England. The generator will be provided with Siemens system of axial ventilation so arranged that the hottest temperature in the machine can be measured. The rotor will be of the solid type. In addition to the above generator the Siemens Company have already supplied or have on order for the city of Edmonton:—One 2,000 kw. turbo-generator, one 750 kw. street railway generator, and one 425 h.p. induction motor.

A Busy Month Along the Coast

On January 1st, 1913, the new rules of the British Columbia Government, regulating the operation of electric railways within the limits of the province, came into force. The important items of the new rules cover the limitation of the number of passengers allowed on the cars and the provision of gates or doors at the entrance or exit of all cars. The thirty-five city cars recently purchased by the B. C. Electric Railway from the Brill Company, are equipped with gates at both the entrance and the exit passages of the rear platform, the controlling levers being operated by the conductor. The exit door of the front platform is combined in operation with a folding step. As the rear platform gates are flush with the body of the car and open outward, there is no chance of persons attempting to board the car at either



B. C. E. R. gates

platform while it is in motion, thus giving additional protection from step accidents. A number of the gate cars are now in service in Vancouver and the B. C. Electric will install gates on all its cars as traffic demands permit.

The regulation governing the capacity of the cars stipulate that a load shall be the sitting capacity of the car and one standing passenger for each four square feet of standing room. When the capacity of the car is reached, a sign "Car Full" is displayed over the entrance to the rear platform and additional passengers are not taken on until passengers have left the car. Signs are posted in each car giving the seating and standing capacity according to the new regulations. The regulations now make it an offence against the provincial law for persons to ride on the steps of the car and the company and the conductors in charge are directed to see that this rule is enforced. The regulations demand that all city street cars must be of the double truck type and that the height of the step from the ground to the first step must not exceed 16 inches.

New Westminster Gets Good Contract

The city authorities of New Westminster have entered into a contract with the B. C. Electric Railway Company for electric current for the municipal lighting plant, the agreement covering a period of 11 years from January 1, 1913. The New Westminster authorities control the public and private lighting facilities in the city and have been securing their power from the B. C. Electric on a contract which expired December 31, 1913. Recently the council called for tenders for current for its lighting plant for a period of ten years. On December 24th two tenders were opened, these being presented by the B. C. Electric and the Western Canada Power Company. The B. C. Electric offered current to be delivered to the city at the company's sub-station at 2300 volts for 1.25 cents per kw. hour. The company was to furnish switchboard, regulators, transformers, etc., and also to bear the operating expenses of the sub-station. The city was to guarantee a minimum annual output of 2,500,000 kw. hours. Should the city desire and could satisfactory arrangements be made the company would erect a second sub-station so that current could be taken from two points. The Western Canada Power Company submitted an offer for 1.5 cents per kw. hour, the city to provide a sub-station and the company to provide the electrical apparatus and be responsible for the operating expenses in connection with the station. As an alternate offer, the Western Canada Power Company submitted the price of 1.3 cents per hour should the city erect, equip and maintain the sub-station.

On its present contract the city was paying the B. C. Electric 1.46 cents per kw. hour and contributing $100 per month for the up-keep of the sub-station. In view of the better terms offered by the B. C. Electric, an arrangement was made between the company and the city whereby the remaining year of the old contract was transferred and a new agreement for an 11-year term entered into at the lower rate noted in the company's tender.

Destructive Gales

On December 30-31st a gale of unusual violence occurred on the British Columbia coast causing considerable damage to the light and power lines of the British Columbia Electric Railway. The gale swept up the Fraser River with great violence, wrecking the three high towers which carried the light and power lines of the company from Lulu Island to Ladner and the Delta district. These towers were of heavy timber construction and 320, 250 and 175 feet in height respectively. The foundations of the highest tower were partially washed away owing to the changing of the course of the Fraser during the flood and this tower succumbed to the force of the wind, the others falling shortly after. The company is replacing this connection with the Delta district by pole lines giving land connection. In Vancouver the full force of linemen were kept on duty day and night attending to the many trouble calls on account of the gale. During the height of the storm the guy wires of the 165 feet masts carrying the company's lines over the Main street bridge, Vancouver, parted, and for a time these lines were in great danger of falling. All traffic was temporarily suspended over the bridge on account of the danger but the company's linemen succeeded in replacing the guy wires while the gale was still raging. Considerable damage was done by the storm to the electric signs about the city, a number of large constructions of this class on the roofs of high buildings being destroyed.

B.C.E.R. Bond Issue

During the early part of January the B. C. Electric Railway Company, Limited, asked for subscriptions for an issue of £750,000 of 4¼ per cent debentures, the issue being floated at 98. The offer was made in London, the concern being chiefly backed by old country capital. On the closing of the subscription books, it was found that the issue has been oversubscribed. In commenting on the successful floatation the daily press of Vancouver, B.C., in both editorial and news articles called attention to the advantage of the tramway and light and power service of the coast district of British Columbia being under the direction of a company in which such confidence is felt in the old country as was shown by the taking up of such a large loan at this time. The article points out that while the issue of the B. C. Electric was successfully floated, many western muni-

cipalities have been vainly endeavoring throughout the year to float municipal debentures in the Old Country, and, because of their failure to accomplish their ends, have been obliged to issue short term treasury notes bearing a high rate of interest. The new issue of the B. C. Electric is intended to cover the large development works and extensions which the company has in hand for the coming season.

Mr. Sperling Back From Europe

Mr. R. H. Sperling, general manager of the British Columbia Electric Railway Company, returned during the month from an extended trip to the Old Country and Europe. During his stay in London he conferred with the directors of this company concerning the operations in British Columbia. On his return to Vancouver Mr. Sperling was greeted with great enthusiasm by the company's staff and received hearty congratulations on his improvement in health. On January 6th the office staff of the company tendered a formal reception to the general manager in the rooms of the B. C. Electric Social Club. Over 250 were present at this gathering, the principal feature of which was an address by Mr. Sperling, in which he stated that the attitude of the directors toward the Social Club was of a favorable character, as it was believed that such an organization promoted a spirit of cooperation and harmony which it is desirable to secure among the employees.

Miscellaneous

The Port Essington Water Company, Limited, has been granted a certificate of incorporation, head office at Vancouver, B.C.

The Bridge River Power Company, Limited, has been incorporated with a capital of $2,000,000, to carry on the light and power business in all its branches, with head office at Vancouver, B.C.

The equipment for the Penticton, B.C., power plant arrived early in January, and it is expected the plant will be in operation about the middle of February. Mather, Yuill & Company are in charge of the installation.

Messrs. Waugh, Mesner & Bailey, of Vancouver, recently commenced the installation of 219 ornamental cluster light standards to be located on Main street, Granville street, Harris street and Hastings street, Vancouver. All standards will be equipped with five 100-watt tungsten lamps, wired in multiple at 110 volts on 3-wire system.

Mather, Yuill & Company, Vancouver, B.C., have just completed the construction of about twenty-five miles of high tension pole line for the Canadian Collieries, (Dunsmuir), Limited. This line is in connection with their new hydro-electric installation to supply the various coal mines around Comox, Vancouver Island.

The firm of Mather, Yuill & Company, consulting and contracting engineers, Vancouver, B.C., were recently awarded the contract for the supply and installation of a 150-h.p. Diesel engine for the city of Port Alberni, Vancouver Island, B.C. This firm were also awarded the contract for the erection of all other equipment in connection with the power plant.

The Black Mountain Water Company, Limited, has been incorporated with a capital of $600,000, with head office at Kelowna, B.C. In addition to obtaining the usual licenses, the company is empowered to purchase the irrigation works erected by the Belgo-Canadian Fruit Lands Company, together with the lands and rights-of-way used in connection therewith, near Kelowna, B.C.

The 150 h.p. Diesel engine, Westinghouse generator and switchboards have arrived at the city of Vernon, B.C., and are now in course of erection. The 150 h.p. Diesel engine has also arrived for the municipality of Spallumchean, Armstrong, B.C., and is now being erected. Mather, Yuill & Company are installing both these plants and expect to have them in operation by the end of January.

During the month the British Columbia Electric Railway inauguarated a service over its new track on the Lulu Island line between Vancouver and Eburne. This line belongs to the C.P.R. and is operated by the B.C. Electric on a long lease. As originally constructed the entire line was a single track, but, owing to the rapid development in the Point Grey district, due to suburban settlement, traffic demands have increased so that a double track from Vancouver to Eburne was constructed last year. Operating over the double track line a 15-minute service is now given during the rush hours between Vancouver and Eburne.

The B. C. Electric Railway Company has concluded arrangements with the authorities of New Westminster for the establishment of a terminal yard in that city. The location of the yard is on a block between 4th and 5th avenues and 14th and 15th streets. The plans call for a construction of 19 separate tracks for main lines and switching, the total trackage of the yard being about three miles. This yard will be connected with the three interurban lines operating between New Westminster and Vancouver as well as the three suburban and interurban lines operating to the south and west of the city, the principal division being that operating through the South Fraser Valley to Chilliwack.

During the month the British Columbia Electric Railway Company operated a "nearside" car over its Vancouver line. The car is similar in type to those now used in Philadelphia, it being supplied by the J. G. Brill Company. A careful watch was kept during the test runs to ascertain whether the car showed any improvement in the handling of traffic. These figures have not yet been given out by the company owing to the desirability of still further testing the type of car. The B. C. Electric has recently received from the J. G. Brill Company a stepless centre entrance car, similar to the "5,000" type in use in New York City. The car is now being made ready for operation and will probably be taken out on test runs during the month.

To accommodate the demands of the merchants of Vancouver and New Westminster and the settlers and retail stores scattered throughout the South Fraser Valley, the B. C. Electric has just instituted a fast daily express service between Vancouver and New Westminster and Chilliwack. The train leaves Vancouver early in the morning, arriving at Chilliwack about 1 p.m., the return trip being made so that the train arrives in Vancouver during the early evening. This service will be of great value during the summer when large shipments of produce come to New Westminster and Vancouver from the South Fraser district, the train being so timed as to bring the produce in fresh condition to the market.

Canadian Telephone Progress

Previous to the 10th of November last, telephone communication between Vancouver and North Vancouver was maintained by means of cables which crossed the First Narrows of Burrard Inlet in the water mains of the Vancouver city waterworks department. The large increase in telephone business between these cities during the latter part of 1912 rendered the old circuits inadequate, and in order to provide an improved service the B. C. Telephone Company decided to lay a submarine cable across Burrard Inlet. This cable—probably the first of its type to be installed on the American Continent—is a 50 pr. 19 ga. Nutti duplex, paper insulated, lead covered, single armoured submarine 12,407 feet in length. It was manufactured by the British Insulated & Helsby Company, London, in accordance with the B. C. Telephone Company's specifications, and was shipped on three reels, each weighing eighteen tons.

In a duplex cable of this type, two conductors are twisted together, thus forming a pair. Two such pairs are then twisted together, forming what is known as a quad. Two of these quads are next intertwined, forming a secondary quad, the object of this form of cabling being to allow the use of phantom circuits, and also the phantoming of the phantom circuits. The cable contains 12 secondary quads and 1 quad, thus making it possible to secure 87 talking circuits. Because of the capacity, unbalance between conductors in each section of cables, it was found necessary to test the three sections of this cable in order to locate the various conductors whose capacity unbalances, when spliced together, would tend to neutralize each other and ensure freedom from cross talk.

Telephone cable on scow

The tests were made by the Engineering Department of the British Columbia Telephone Company, and a Capacity Unbalance Testing Set was used for the purpose. That the selection of conductors was successful is evident from the fact that there is absolutely no cross talk.

The cable was laid between Vancouver and North Vancouver on November 10, 1912, the time consumed in the process being about one and a half hours. The cable was unreeled and coiled on a scow, the ends of each section being thoroughly tested and spliced as the cable came off the reel. The scow was equipped with a gallows frame amidships, and an 18-in. shear at the stern, the cable passing from the forward end of the scow over the frame, and then over the shear as the scow was towed along. The splices were relieved of strain by making a rope fast ahead of each, and allowing the rope to bear the strain until the splice was on bottom, the rope being then cast off. The average depth of water along the course is about 100 feet. The standard cable equivalent of the submarine in place is two and a half miles. (Standard cable—.054 M.F. 88 ohms. per mile). Twenty of the circuits are at present in use and the cable has proved satisfactory in all respects.

Much careful work is required in perfecting a connection of this kind, and considerable of this fell to the lot of Mr. E. P. Labelle, plant engineer of the B. C. Telephone Company, and Mr. A. H. Lemmon, district engineer. Laying of this connection was effected under the direction of Mr. G. McCartney, superintendent of construction, assisted by Mr. H. B. Noble, division foreman, and Mr. E. W. Thomas, construction engineer.

Pure Enunciation

To eliminate enunciation troubles, the Traffic Department of the British Columbia Telephone Company, Vancouver, B.C., has begun the training of the voices of operators. This work is under the supervision of the training school principal, who has secured the services of a competent elocution teacher. The company has a situation that is no doubt exceptional, in that young ladies of so many different nationalities are employed as operators. While all these speak the English language, it is rather a variation of that language, hence the need for a school where prospective telephone operators will be instructed in the duties which, as operators, will fall upon them.

All student operators will be given a course in voice culture, which besides the regular voice training practices, consists of breathing and calisthenic exercises. All operators will be thoroughly drilled in the pronunciation of the phrases given in the company's operating practices, as well as in numbers and central office prefixes. Because an operator is trained to act quickly, the natural inclination is to speak quickly, to mumble her words, and to cut out before the repetition is complete. The elocution teacher's endeavors will be to train the operator to speak slowly and as far as is possible to have all operators speak the "Canadian language." The classes now conducted are in one of the exchange buildings. Because of the growth of the traffic department and the increasing demands on it, through the development of the company, the erection of a separate building for school purposes has been found necessary. Plans for a suitable structure were prepared by the company's engineers last November, and building operations were commenced without delay on the site chosen, at the corner of 10th avenue and Prince Edward street, Vancouver, adjoining the Fairmont Telephone Exchange. The building measures 36 x 58 feet, and is of steel frame construction faced with buff pressed brick and stone. All floors are cement, and hollow tile is being used for the partitions. Provision is made for the addition of several storeys in the future.

All interior woodwork is B. C. fir. Upwards of forty pupils can be accommodated in the school at one time. The construction department of the B. C. Telephone Company is erecting the building.

Yarmouth, N. S.

The new switchboard in Yarmouth, N.S., was successfully put into operation on the 4th of December, 1912. In addition to this the Maritime Telegraph and Telephone Company, cut over a new switchboard in Glace Bay on October 9th, and a new toll board in Halifax, on November 30th. Yarmouth now has a modern common battery No. 10 switchboard located in an attractive concrete and stone building. The building is two-storeys and fire proof throughout. On the first floor are the commercial and manager's offices, and the work shop. The second floor contains the battery room, wire chief's room with the main frame and power apparatus, the switchboard room and the operator's rest room. The

building has good light on all four sides, which makes all the rooms very bright and pleasant for the employees.

The switchboard is a four position No. 10 Common Battery Board. There is one straight toll position, one combination recording, rural line and toll position and two local positions. An intermediate distributing frame associated with the switchboard makes it possible to arrange the lines on each position as to give each operator a good load and and thus prevent any delays due to an overloaded position. Another good feature regarding the arrangement of this switchboard is that extensions can be made to it in both directions. Additional toll sections can be added to the right hand side of the board to handle growth in the toll business and the local sections can be extended to the left hand side of the board.

The work of installation of the Yarmouth board occupied a period of only seven weeks. Messrs. Felix & Soule, of the Northern Electric had charge of the work.

New Bell Buildings

The Bell Telephone Company of Canada will shortly erect buildings of their regulation standard—two-storey, with high basement, brick and stone front, fireproof construction—in Belleville, Guelph, North Bay, Sudbury, St. Catharines, and Brockville. In Toronto, the company will build a new Hillcrest exchange on north Bathurst street, as well as a new structure at Eglinton. These buildings will be similar to the present "North" exchange building in Toronto. In Ottawa a new exchange building will be erected on First Avenue, near Bank street, similar in structure to the present "Rideau" exchange. In Sherbrooke, Que., the company will erect a three-storey building at Strathcona Square and Terrace street. A contract has been let for a new exchange at Outremont, P.Q.; it will have a frontage of 100 feet and will be two storeys high.

Extensions in Scarboro Township

At the recent annual meeting of the Scarboro Telephone Company, it was stated that the total number of telephones now installed is nearly 400, of which 50 have been added during the past year. The indebtedness of the company is being reduced and at the same time ample allowance is being made for depreciation. It was decided that in the event of the Hydro-electric Commission deciding to operate throughout this township, the company should approach them with a view to having distribution power lines run along telephone poles. This would result in a reduced cost in power and light to the consumer and should also tend to reduce the telephone cost. Councillor Mr. G. B. Little was elected president of the company.

Miscellaneous

On January 1, 1912, the British Government took over the assets of the National Telephone Company, of the United Kingdom. The sum to be paid to the company was submitted to arbitration, though the amount asked was $105,000,000. During the trial, which has lasted some two and one-half months, several concessions were made by the company which it was expected would reduce this sum to $80,000,000 or $90,000,000. The decision of the Commission, however, is said to be a great surprise to all concerned, and places the sum payable by the government to the company at only $62,576,320. The Commission consisted of five judges of the High Court.

The Bell Telephone Company will make a new stock issue of $3,000,000, bringing their total issue to $18,000,000. Each stockholder of record January 15 is entitled to take at par shares of the new stock in the proportion of one share for every five shares held. The right to subscribe expires on February 28.

On February 1, the flat rate goes into force over a considerably larger area in Montreal, following the recent decision of the Railway Commission which had the matter in charge. It is said that many suburban residents of Montreal will now get their telephone service cheaper by amounts varying from $5 to $20 per year.

The British Columbia Telephone Company is said to be preparing plans to build a line to Kalso from its present terminus at Kakanee. It is also said that an exchange will be established at Kalso and service provided for surrounding districts.

The number of telephones operated in Vancouver city during 1912 by the British Columbia Telephone Company was 16,160. At the end of 1913 this number has been increased to 21,321, an actual increase of 5,161.

It is said that some $5,000,000 will be expended on the Alberta telephone system during the year 1913 and that this has already been provided for by the sale of government securities to this amount in the old land.

De Laval Type Steam Turbines

Messrs. Taylor & Young, consulting engineers, Metropolitan Building, Vancouver, B.C., were recently awarded a contract by the Dominion Government, Department of Dredges, for the supply and installation of a De Laval steam turbine of the single-stage geared type. The machine supplied by this firm, who are engineers for the De Laval Company, and specialists in this class of installation, is a 4.6 kw. 125 volts, Direct Current Generating Set, consisting of one De Laval class "A" 7 h.p., 3,000 r.p.m. single geared steam turbine, direct connected to one Crocker-Wheeler 4.6 kw. 125 volts direct current generator, generator and turbine to be mounted on a suitable bed plate. The turbine is designed to carry the full load of the generator on either steam at 150 pounds steam pressure at the turbine throttle, with six pounds absolute vacuum at the turbine exhaust, or with 150 pounds pressure at the turbine throttle and atmospheric pressure at the turbine exhaust.

In this class of turbine the steam is expanded completely to the terminal pressure in one set of nozzles, and impinges against a single row of blades or buckets carried by a single wheel. The speed is reduced by means of a helical pinion and gear to suit the driven machine.

An important feature of this turbine is the advantage it possesses over multi-stage turbines in regard to its ability to carry overloads. In order to carry an overload with the De Laval turbine it is only necessary to open more nozzles, and since these nozzles work at the maximum efficiency, with the losses due to windage and disc friction remaining as before, the efficiency of the turbine is increased. Some multi-stage turbines admit steam around the entire circumference of each stage, while others use partial admission in the first few stages, with complete circumferential admission in the latter stages. In either case it is impossible to increase the power output above a certain maximum without admitting a steam at higher pressure to an intermediate stage. The total range of expansion must then take place between such intermediate stage and the exhaust end of the turbine, and, inasmuch as that part of the turbine is designed for only a fraction of the total range of expansion, the op-

eration of a multi-stage turbine under overload conditions is necessarily inefficient.

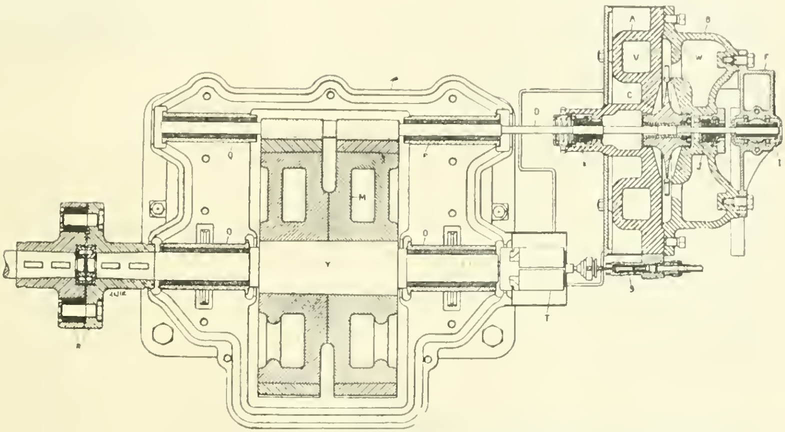
Speed reduced by gears is the peculiar and distinguishing feature of the De Laval turbine, and to it are due many possibilities and exclusive advantages. There is a general and natural objection to the introduction of gears where they can be avoided, but here, as in all branches of engineering design, the advantages and disadvantages of one construction have to be balanced against those of another before a final judgment can be passed. In other words, the use of gears eliminates certain undesirable features, therefore if gears can be made that will perform the duty, with low cost for maintenance, little attention and good efficiency, is not the use of such gears the logical procedure?

By the adoption of gears, the De Laval Company is enabled to use the most simple and efficient type of wheel, viz., the single impulse wheel, and to run the driven machine at the most desirable speed. In non-geared turbines this compromise, which has here been effected by means of the gear, must be made by pressure or velocity compounding, or both, but the resulting complication is greater, and the results are not so satisfactory as when the speed reduction is secured by the simple expedient of a gear. At best, the compounded turbine does not run as fast as could be desired on the grounds of efficiency, and the driven machine is compelled to run too fast. This is true to a greater extent than is generally appreciated, as the usual turbine speeds are altogether too high for direct-current generators, and the construction of high speed alternators involves many difficulties. It is almost impossible to build a commutator having sufficient current-carrying capacity and, at the same time, to keep its peripheral speed within practical limits. Therefore, where direct current machines are driven from multi-stage turbines, it will usually be found that two or more small-diameter commutators, occupying considerable length on the shaft, are required. The maintenance of these commutators in balance presents a problem beyond the skill of the ordinary operating engineer. In the case of alternating current machinery, the efficiency of the generator must be sacrificed to some extent by reason of the small diameter and limited space available. While it may be possible for the manufacturer to balance the rotating part satisfactorily at the shop, the balance is not always retained subsequently, when, due to changes in the thickness of the insulation, the copper conductors become displaced, and, even if this displacement is very small, it will produce troublesome vibrations.

The difficulties of a proper speed compromise by compounding alone are well illustrated in the case of ship propulsion, for which service several builders of multi-stage turbines have recently proposed the use of gears that in all essential respects are identical with the gears used in the De Laval turbine for the past twenty years. Now, if ships costing several million dollars and dependent for their safety upon the absolute reliability of their driving mechanism, are to rely upon the continuous operation of gears subjected day in and day out to the extraordinary severe racking and vibration, it is conclusive evidence that these turbine builders are thoroughly convinced of the durable and reliable character of this type of gear.

To return to considerations which relate more exclusively to stationary steam turbines it will be found that the losses of energy in the gears are more than made up by the increased efficiency of the turbine and of the driven machine. Numerous tests made by the De Laval Company and others, have shown that the mechanical efficiency of the De Laval gear is between 98 and 99 per cent.

The De Laval gear is of the herring bone or helical type, and consists of two parts—a double pinion cut directly upon the turbine wheel shaft and either one or two double gear wheels mounted upon the secondary or driven shaft or shafts. A fine pitch is used for the teeth in order that a large number may be in contact at one time, thereby reducing the unit pressure set up between the surfaces of the teeth, thus preventing the lubricant from being forced out and keeping down the unit stress in the metal of the teeth, so that there is no danger of breakage. The teeth are cut on a spiral making an angle of 45 deg. with the axis of the shaft, and as there are two sets of teeth inclined in opposite directions, the centering of the pinion and the distribution of the pressure are automatic. The material from which the teeth of the pinion and gear wheels are formed is a high-grade steel, and the teeth are cut by special gear cutters, which were designed and built for this purpose. Long experience has shown that the success of the gear depends largely upon its initial correctness and finish. The pinion is solid, but the gear wheel is built up of a cast-iron drum upon which a seamless ring of steel is forced. After the pinion and the gear have been cut they are polished by a special process.



De Laval single-stage, geared type, steam turbine

125 Miles More Line

The Hydro-Electric Power Commission of Ontario will issue specifications around the end of January and will call for tenders in March, for the various materials in connection with the construction of approximately 125 miles of double circuit transmission line at 110,000 volts and the equipping of sub-stations for the transforming of 20,000 h.p. from 110,000 to 13,200 volts. Various types of apparatus will be considered; for instance, different materials for conductors and different types of steel construction for supports.

The Manufacture of Wire and Cable

A Minute Description, with illustrations, of the Successive Manufacturing Stages, with the Machines used, in Their Production

By Mr. H. O. Blatt*

In the following paper an attempt is made to describe step by step the interesting process in the manufacture of wire and cable in its various forms starting with the rod and ending with the finished product. The machines described and the process of manufacture at every point have particular reference to the plant of the Imperial Wire & Cable Company, Limited, Montreal.

Wire Drawing

Raw copper for use in this department comes to it in the shape of rods—that is the output of the "rolling" mill, in contra-distinction to wire, the output of a "drawing" mill. The rods come to the wire mill in the shape of coils weighing approximately two hundred and twenty-five pounds each, and in outside appearance resemble iron. This blackening on the outside is produced in the rod mill and is the oxide formed when the copper, after having passed through the rolls, is left to cool. These rods are supplied ordinarily in circular cross-section and in sizes from ¼-inch to ¾-inch in diameter, although special shapes, such as rectangular for magnet wire, or "figure eight" for trolley wire, are supplied.

The first operation on the rods, in order to make the product clean and the material more easily worked, is to get this heavy copper oxide off the outside. To do this, the coils are soaked for a time in large tanks containing acid and then very thoroughly washed in running water, after which they have a dull copper color. It is necessary to remove every trace of the acid, in order to have the copper in the best condition for the subsequent drawing operations, especially on the smaller sizes. Before the rods are taken to the drawing machines, each coil is dipped in a soapy solution which puts a film over the copper that helps to neutralize the acid and also forms a lubricant which assists the copper in its reduction through the die.

One end of every rod is next put into a swadging machine where the rapidly revolving pieces of steel taper it to a point small enough to be easily passed through the hole in the die. The tapered end of the copper rod is then inserted in the hole and beyond the end of the die, and, with a pull applied to the end extending beyond the die, a wire of the size of the hole is produced. A reference to the sketch of the wire and die will serve to illustrate clearly this part of the operation. The dies used in drawing copper are, as a general rule, made of chilled iron, steel or diamond. The process of drawing the copper hardens it, and after a certain number of reductions, it becomes so hard that before any further reductions can be made, it is necessary to anneal. The process of annealing consists in bringing the copper to a red heat in a furnace and then plunging in cold water, or, allowing to cool off gradually, either of which leaves the copper soft and pliable. Sudden cooling of copper does not harden it, as in the case of steel.

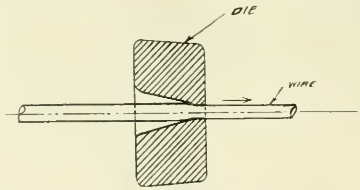


Fig. 1

In deciding the size of the rod to use, it is necessary to consider, in material of circular cross-section, just what physical or electrical requirements are to be met, viz., the tensile strength, elongation, conductivity, etc., and in rectangular or square sections for magnet wire, what the area and finish of the completed article is to be. There are many kinds of machines used for drawing copper, the usual ones being "bull-blocks," "draw-benches" and "continuous." "Bull-blocks" are used for producing the large sizes of wires where a single reduction from one size to another is all that is wanted. The "draw-bench" is a machine composed of a number of blocks, and here the coils of wire are passed from one block to the other, when the reduction from one size to another is effected. "Continuous" machines, as their name implies, produce the finished wire in one operation, and as many as nine reductions are made at one time.

For producing trolley-wire, the bull-block is the machine used, and, for the most popular size, (.365-inch) a ⅝-inch or ¾-inch rod is required. It is desirable in trolley wire to have it as hard as possible, and the largest rod that can be drawn to the size required without annealing, is the one chosen. As trolley wire is always desired in long lengths, usually one mile, the several coils used to make up the length are joined by brazing with silver solder, and the entire length passed through the die. If the brazed joints are strong enough to withstand the action of this reduction, there is slight danger of the trolley wire ever parting at the joint.

The "continuous" machines produce the finished wire at a high rate of speed; a delivery of twelve hundred feet a minute is not uncommon. The large wire entering the machine is pulled through the first die by one of the revolving parts of the machine known as the "chill"; here it is pulled through the next smaller die by the chill adjoining, which revolves sufficiently rapidly to take up the increase of length, due to the reduction in the cross section. This series of operations is continued to the end of the machine, where the finished wire is either taken up automatically in a coil or on a spool.

Copper for use in winding magnets is manufactured in round, square or rectangular sections, and a special machine is required to turn out the square and rectangular. As a general rule, the square and rectangular sections are made by rolling, although the larger sections may be drawn, the holes in the dies having the dimensions of the desired finished article. The square and round sections that are not drawn are put in a rolling machine which is equipped with four steel rolls set at right angles to each other and arranged so that any roll can be moved in or out from the center, as desired. By a series of passes through these rolls, a great variety of shapes is produced. Some of this special shaped copper is shipped in the uninsulated state; the major portion, however, goes to the magnet wire department to be covered with one, two or three layers of "combed sea island" cotton.

The diamond dies previously mentioned for use on fine wire are used on sizes .064-inch and smaller. The black diamond is sufficiently hard to stand the strain of the reduction and can be polished smooth enough to allow the easy passage of copper through it. There are other materials of

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the same general nature used, but their life is short and they do not give the general satisfaction the diamond does. It is interesting to note that the hole in the diamond is pierced by a revolving steel drill, the end of which is previously dip-

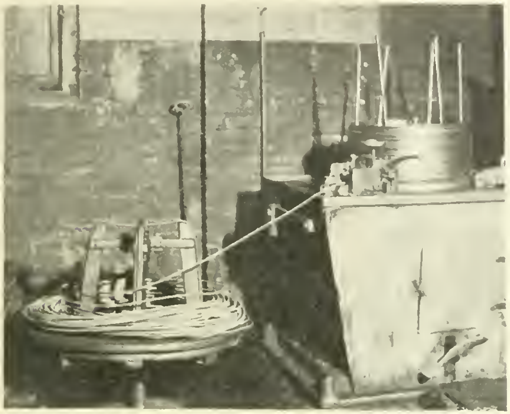


Fig. 2 Bull-Block

ped in diamond dust and oil. Either side is afterward bell mouthed and the pierced diamond mounted in a brass casing, with the sides of the hole at right angles to the face of the casing. These dies are one of the expensive items entering into the manufacture of the finer sizes of copper wire, the price ranging from \$5 to \$70 each. It is necessary to have a stock valued at several thousand dollars, in order to be in a position to supply the trade with the range of sizes required. Copper wire No. 40 B and S gauge, or .003145-inch, is the finest called for in any quantities, although five sizes smaller can be drawn.

Testing and Distribution

Although the output is principally copper, large quantities of brass, aluminum and copper steel are produced. These are manufactured in the same general way as copper, but each requires its own special method of treatment. For all insulations except rubber—that is, where the rubber is going directly on the conductor—the copper is now a finished article of this department. To be suitable for rubber insulation, the copper must have a thick covering of pure tin over its entire surface. The tinning is done by pulling the wires, several at a time, through a molten tin bath, having previously passed through acid and water baths to remove all grease or dirt. This tinned wire is then passed to the inspection department, and, when it has met the tests prescribed, by this department, it is sent to the rubber insulating department. The uninsulated copper after passing the inspectors, is passed to the stranding, weather-proof or other departments where it is insulated in the untinned state.

The testing laboratory for use on the products of this department is equipped with the most modern instruments for determining the properties of the copper, such as, conductivity, tensile strength, elongation, ductility, etc. For the conductivity test, the Hoopes Bridge is used, in which the percentage is read off directly on the graduated scale. The company's standard for this property is set at 100 per cent. for annealed copper and 97 per cent. for hard drawn, and tests are made at regular intervals to insure the copper being up to the standard set. A Riehle horizontal tensile strength machine having a capacity of 10,000 pounds is used to determine the tensile strength and elongation of the hard drawn line and trolley wires. Wires manufactured to a specification calling for a ductility test are also put in a testing machine designed specially for that purpose.

Rubber Insulating

The most important ingredient in the rubber insulation, generally termed the "compound," is Upriver Fine Para. This is prepared from the latex of the rubber tree. This latex or sap slowly oozes from incisions made in the bark of the tree and is collected in small cups placed beneath. The contents of these cups is collected during the day and at night is taken to the camps to be coagulated; that is the name given to the process of driving out moisture and hardening the milk. The smoking process originally used by the natives and the standard to-day is much as follows:—A fire is made of palm nuts or hardwood, which give off heavy smoke containing creosote, acetic acid, etc. A long rod or paddle, supported at one end by a cross piece and at the other by the operator's knee, is held in the volume of smoke. The operator pours a quantity of latex over the rod and turns it in the smoke until a hard film is formed. A fresh quantity of latex is poured on, smoke again applied, and this continued until a 20 to 100 pound ball or biscuit, consisting of innumerable layers, is formed. After the pole is removed and the ball stamped, the rubber is ready for export to the factories.

The first operation on this crude rubber in the factory, is washing. This is done between two powerful revolving rolls, which have a fluted surface for tearing the elastic fibres apart. Water is kept flowing over the rolls while this operation is in progress, so that all bark, sand or other foreign matter is dislodged and washed off. The rubber is taken from these rolls in sheets about six feet in length and hung in heated ovens, or put under vacuum to remove all moisture. The vacuum method of drying will accomplish in a few hours, what will require about ten days in heated ovens.

The rubber, after this washing and drying, is in a condition to be mixed or compounded. The purest compound is rubber with a percentage of sulphur. Two steam heated and water cooled rolls about 20 inches in diameter, are used to mix the different ingredients with the rubber, to form the compound. The rolls have a smooth surface and are revolved at different speeds to produce the mixing. One hun-

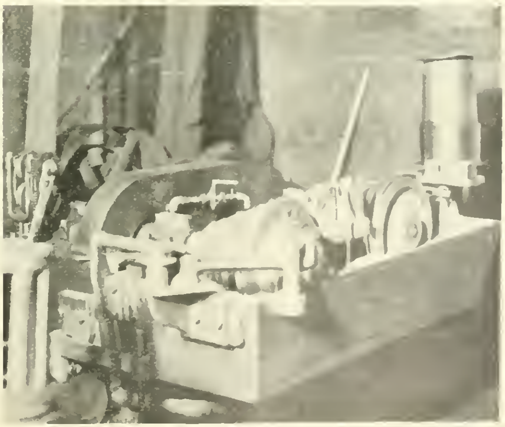


Fig. 3 Continuous wire-drawing machine

dred and fifty to two hundred pound batches are mixed at one time, and require about one half hour to mix, Fig 4. The amount of any one ingredient entering into the compound varies with the grade desired. Compounds for insulating wires must be free from foreign matter, such as metal,

wood, fibre, etc., as a piece of any of these imbedded in the wall of the insulation will make it defective. For this reason, all the ingredients must be as clean as it is possible to make them and the wire manufacturer must be constantly on the alert, devising means to eliminate these destructive elements. All powders used must be put through fine mesh sieves, to make sure no foreign matter remains, and all waxes or oils must be thoroughly strained before being used.

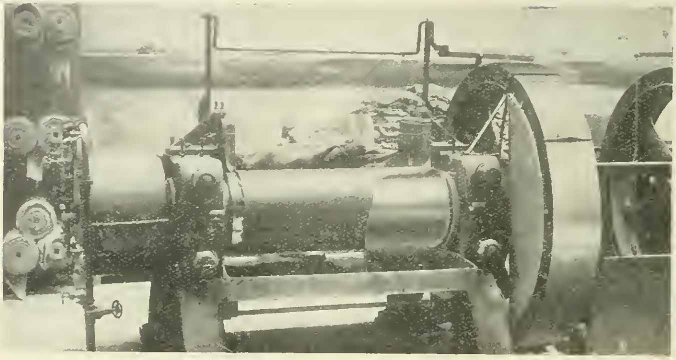


Fig. 4—Rubber mixing machine

The compound is applied to the wire generally, in three different ways:—One is to wrap the thin strip spirally around the wire, a second, to squeeze the strip between two grooved rolls—known as the strip method—and a third, —known as the seamless method—is to force the compound around the wire in a tube machine, Fig. 5. Of the three methods referred to, the first is the oldest and now the least used, and this only on large cables. After the regular mixing, the compound is ready for the tube machine, but to be suitable for the strip machine, it is necessary to make it into thin strips of various widths and thicknesses. This is done by passing the compound through the steam heated rolls on a machine called the "callender," where it is sheeted out as desired. The compound is put in on one side of the machine and rolled up between strips of cotton cloth on the other side, the cloth keeping the several wraps of rubber separated, until they are wanted at the strip machine.

In the strip method, the two sheets of compound from the callender are passed through the grooved rolls and squeezed around the wire; the excess on either side of the wire is pressed off and the wire left surrounded by the compound has two seams. In the seamless method, the operation is the same as in the ordinary sausage grinder. The compound is fed into the hopper at the back of the machine, and the worm forces the compound around the wire, and the insulated wire, without a seam, comes out of the front of the machine.

After the compound is on the wire, if there is to be an outside protective covering, there are two general methods of procedure. One is—first to vulcanize and then braid, the other—to braid and then vulcanize. The vulcanization, or what is commonly called curing, is the result of keeping the compound containing sulphur in a steam heated oven for a definite time and gradual increase of temperature. If this has been properly done, the compound has high insulating and wearing qualities. Uncured rubber when stretched will not return to its original condition, whereas the cured, returns to its original shape, and that, directly the pressure is removed. Without this cure, the compound is lifeless and of little value as an insulation.

Whether the braid is put on before or after the cure, depends upon the insulating machine; if from the tube machine, it is put on after the cure; if from the strip machine, the braid is put on before. From the tube machine, the insulated wire is put in large pans containing soapstone. The soapstone is used to keep the wires from touching each other, and to form a cushion for the hot plastic compound that would flatten without it. As the compound is soft and very easily damaged when coming out of the tube machine, great care must be taken to prevent holes being made in the insulation, and the under covering becoming flat.

The braid is put on by machines, the elementary principle of which is the familiar May-pole Dance. The tubes containing the material for the braid are sent in and out around the table of the braiding machine, and a continuous layer of the material is formed around the wire, Fig. 6. The oldest and most widely used machine turns out five hundred feet per day, depending upon the style of wire, although there is a high speed machine now on the market, which braids five times this quantity per day. The kind of material used for this outside covering varies; braids of cotton, jute, asbestos, silk, wool, etc., are used. In the cotton braid, there are two kinds—the soft and the glazed. The soft cotton is, as a rule, used where the braid is to be covered with a wax; the glazed, being stronger than the soft, is used on wires which are subjected to considerable handling, or where appearance is important. The glazed braid is used largely on telephone wires that are intended for inside house-wiring.

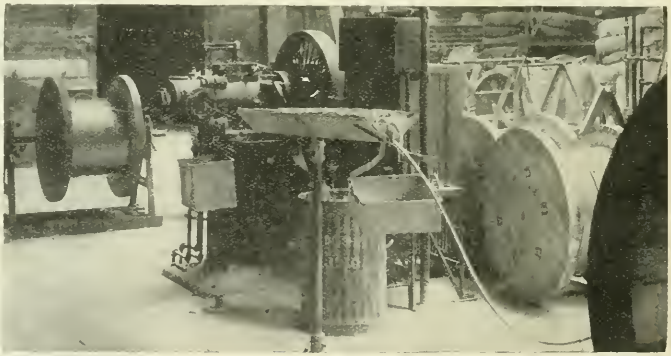


Fig. 5—Tubing machine—Wire being insulated

After the wires coming from the strip machines are braided and vulcanized, they are ready for the finishing operations. If braided with glazed cotton and there is no special treatment of the braid called for, the wire is measured, coiled and tagged, ready for inspection. The soft cotton braided wires are run through tanks containing

a black insulating wax, and this, in the hot state, is absorbed by the braid, forming a covering which is waterproof and capable of taking a high polish. The wax also prevents the rapid deterioration of the cotton braid. The polishing of the waxed wire is done in a machine composed of revolving dies, which travel at a very high speed around the wire, as it is being pulled through.

After the polishing of the waxed and the coiling of the plain braided wires, the final operation before shipment is inspection. The Imperial Wire and Cable Company is a subscriber to the label service of the National Board of Fire Underwriters, and all the code wires must pass the tests prescribed by that Board before they can bear the label. The wire for this inspection is submerged in large tanks for twelve hours, and then the tests for high voltage breakdown and insulation resistance are made. A transformer of 100 kilowatts capacity and capable of producing 100,000 volts, is used for the puncture test. Besides the electrical tests there are the regular mechanical and chemical tests to be made on the rubber. To pass of the rubber must be greater than 400 the mechanical tests, the tensile strength pounds per square inch and to be sure that the rubber has been properly vulcanized, elongation and permanent set tests are prescribed. The wire is also bent around a steel spindle, and, when in this condition, must withstand a breakdown test, and the insulation must not crack. Very elaborate chemical tests must be made to determine the amount of rubber contained in the insulation. Any coils of wire failing to pass any of the electrical, mechanical or chemical tests are rejected. The representative of the National Board of Fire Underwriters oversees all tests made in the factory and, in addition, has access to the stockroom where he is free to choose coils for further check tests. By a system of inspection in the field, they are kept constantly in touch with the company's product; the Board even buys coils of wire in the field, to make check tests.

Weatherproof Wires and Cables.

Both copper and aluminum conductors are produced in very large quantities. This department is one of the largest in the company and is equipped to supply the trade with everything in weatherproof, from the smallest wire to the largest circular mill cable. Large quantities of the standard sizes are always carried in stock, so that orders can be filled promptly. The solid or stranded copper or aluminum is sent to this department usually thoroughly annealed, although in special cases, hard drawn wires are used. Two or three braids of unbleached cotton are put on in a braiding machine, similar to those described under rubber covered wire. The cotton used for the braid is thick enough for the service requirements and the strands of cotton are laid closely enough, to ensure a continuous cover in each layer. In order to make this covering weatherproof and waterproof, it is impregnated with a hot black compound, and so applied, as to fill every part of the braid. The compound used is made up in such a manner that the wire will be serviceable, both in cold and hot weather. It will not become brittle when cold, nor drip from the wire when hot. Over this filling compound, another of a more waxy nature is applied, which will take a very high polish; this is essential where the wire is to give the best service under all conditions of weather. If the wire is to be slow-burning the weatherproof compound is replaced by a fireproof compound and the finish made hard and permanent.

Paper Insulated Telephone Cable

In the manufacture of paper insulated telephone cables the materials used consist briefly of copper, manila paper, lead and tin. The processes, in order, are insulating, twisting, stranding, testing, drying-out, lead-covering, reeling and the final testing. The copper is drawn either in coils or on spools and thoroughly annealed. It is now ready for the

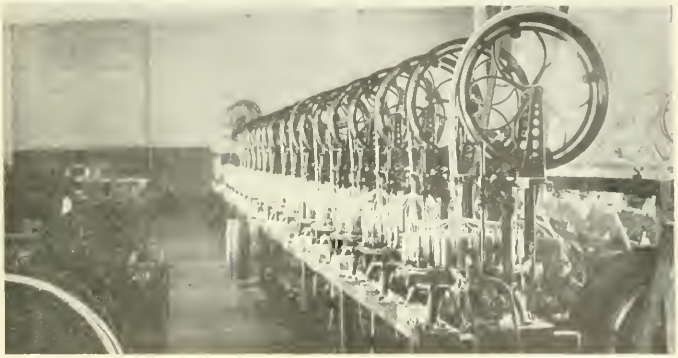


Fig. 6—Braiding machine

first operation—insulating.

The paper used is the best and the most skillfully manufactured of the many kinds on the market. It must be very strong and true to gauge. Only the best manila rope fibre is used in making this paper. The finishing machine alone, employed in the production of this paper, costs one hundred thousand dollars. This will give some idea of the class of machinery necessary to produce paper of the required grade, the greater portion of which is only two and one-half one thousandths of an inch in thickness. The paper is supplied in rolls of any desired width, the pads as used on the insulating machines being made about nine inches in diameter. The insulating machine, consists of revolving heads, which hold the pad of paper and capstans, which pull the wire through and take up spools which receive the finished insulated wire. The wire passes through the center of the pad of paper and the revolving of the head puts a spiral wrap around the wire, as it is pulled through by the capstans, see Fig. 7. This is known as the American method. In the European method the paper is laid longitudinally along the wire and wrapped with cotton string. The American method is preferable, in that it allows a greater air space between the wire and the paper. The color and thickness of paper used in the insulation is determined by the size of wire and the position it is to occupy in the cable.

From the insulating machine, the wire passes on to the twisting machine. This machine is designed to twist the two separately insulated wires together to form a pair. There are several different types of twisting machines, but the underlying principle is the same in all, that is, to wrap each wire about the other, at the same time as the twisted wires are pulled off the spools at a fixed rate. One type of machine consists of a yoke which holds the spools, a capstan which draws the two wires off the spools as they revolve about an axis, and a take-up which receives the twisted wire, as it is drawn off by the capstan. Usually two differently colored insulated wires are twisted to form a pair. The length of twist is determined by the ratio of the revolutions of the yoke, to the distance the capstan travels in the same time. The majority of cables have all pairs twisted with the same number of turns per foot, but some specifications call for a certain number of pairs in a cable to have different lays from

the remaining pairs. The object of having the variety of lays in the cable, is to reduce the self-induction or the "cross-talk," as the wires are less liable to be in a parallel position in the cable, if the number of twists per foot varies.

From the twisting machine the paired wires go to the stranding machine, Fig. 8. This consists of a series of drums, one behind the other, which can be revolved in either direction at any desired speed. Upon the arms of the drums, the spools of twisted wire are held. The twisted pairs are drawn first to the axis and then to the front of the smallest drum on the machine, where they are joined to the core wires that go through the machine, straight, thus forming the first layer. This drum is revolved and the bunch of wires pulled to the front end of the next larger drum ahead, where the wires from this drum are added, making the second layer. As the cable increases in size, a greater number of pairs are added in each layer. These operations are continued until the finished cable reaches the capstan and finally the take-up reel. In order to cut the cable at the length desired by the customer, one of the pairs of wires in the center is carefully measured, and a measuring machine on the front of the strander, checks this measurement. To allow for any possible defects in the cable, a number of pairs extra are made, for instance, in a four hundred pair cable, there are four extra pairs. Outside the stranded cable, two layers of heavy manilla paper are wrapped to protect the wires from the lead sheath.

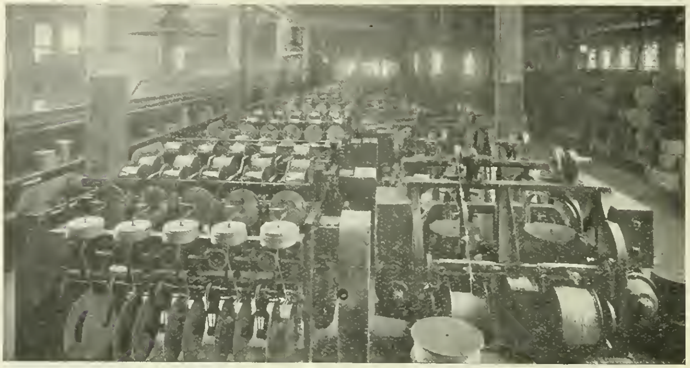


Fig. 7—Paper insulating and twisting machine

After the cable is cut off from the strander and put on the reels, it is ready to be tested for faults before the lead covering is put on. The wires are tested to find any breaks in the copper wire, known as "Opens," and for "Crosses," where one wire touches another. If either defect is found, the outside paper is taken off, and the defective wire located and repairs made.

The next operation is the drying out of the cable before it is lead covered. In order to have the cables test the number of megohms required, all the moisture in the paper must be dried out. This is done in ovens heated to about 250 degrees Fah., where the cable is left for a number of hours. Readings of the oven temperature are taken periodically and recorded, to be sure no cables are lead covered which have not had their proper drying.

The machine, Fig. 9, which covers the cable with the lead sheath is very expensive and requires careful handling by trained men. Water at 6,000 pounds per square inch pressure is delivered from triple acting pumps to the water ram at the bottom of the press. The action of the water is to raise the water ram until it forces the stationary head, or lead ram, down into the cylinder containing the plastic lead. The pressure keeps on forcing the lead past the cylinder into the die block, where it is forced out of the press at right angles to its initial path. In this die block are placed, a core and a die, the core protecting the cable from the lead and forming the inside of the pipe. After one cylinder of lead has been discharged, the press is lowered, another supply of lead drawn from the lead kettle, and the same operation repeated. As the lead pipe is formed around the cable, it also carries the cable out of the press with it. In the front of the press, the lead covered cable is reeled up on the drum on which it is to be shipped. The necessary length is left out of the drum, to enable the final tests to be made. When the cable has cooled, the lead is stripped off the ends and the wires are framed out for testing. At this time, the cable is tested for insulation, capacity and conductor resistance. Test sheets are made out for every length of telephone cable, so that reference can be made at any time, to the test, should any trouble occur after leaving the factory. After the data on the test sheets has been figured and the cable found to fill the specifications in every way, the test wires are cut off at the edge of the sheath and the ends of the sheath carefully soldered up. After the protecting lags have been nailed on the drum, the cable is ready for shipment.

Switchboard cable is another type manufactured by this

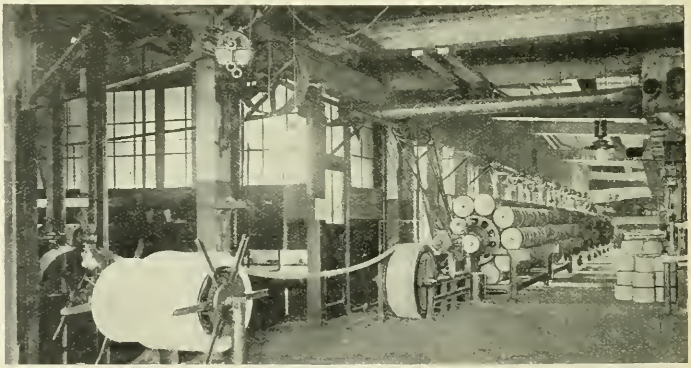


Fig. 8—Telephone stranding machine

company and used in the telephone circuit. In this, the individual wires are insulated with two winds of tussah silk and one wind of cotton, of a great variety of colors. The separately insulated conductors are paired by twisting together and then stranded into the cable in such a manner that all joining can be done by aid of a diagram and observing the colors of the wires, thus avoiding the time and expense of ringing out every wire. These cables, as a rule, are covered with a wrapping of cotton, paper, lead-tape and finally a painted braid, but in special cases, the cable is

saturated in a compound and covered with a lead sheath. The treatment for removal of moisture and the electrical tests are practically the same as for telephone cable.

Paper insulated power cable is wrapped tightly with strips of paper, whereas the paper telephone cable, as previously described, is insulated loosely. This is done on the telephone cable, to reduce the electrostatic capacity as much as possible, as a low capacity means a greater talking distance over a telephone circuit. The same high grade manilla paper is used on this cable, but, as a rule, thinner strips are used on telephone cables than on power cables. In applying this paper to the copper conductor, it is important that no two edges of the paper in successive layers come together; care is taken to have the layers break joints with each other. The papers are put on, as follows:—The large pads of paper are mounted on a revolving drum, spaced uniformly along its length. The end of the conductor to be insulated is brought up to the first pad of paper; this is made fast to it, and the drum revolved, at the same time the cable is pulled through the machine, a distance equal to the width of the paper. The first paper puts a continuous layer over the conductor. When the end of the conductor comes up to the next paper, it is fastened to the first, the third paper fastened to the second, and so on, until all the papers are attached to the conductor as it is pulled at a constant speed through the machine.

The number of papers applied depends on the voltage to be used, and the width of the papers, on the size of the conductors. If the voltage is to be high, a thick wall of paper is put on, and if the conductor is small, narrow papers are used. Single conductor cables are made of solid or stranded copper and of circular cross section. Each conductor of a two conductor cable is usually of circular cross section, but are sometimes called for, made in "kidney" shape, in order to save space. Three conductor cables are made up of circular cross section or sector shaped single conductors. After each conductor has had the specified thickness of paper put on and a multiple conductor cable is to be made, the separately insulated conductors are stranded together and a belt of paper wound over all.

For the insulation resistance to be high and the cable to stand a high voltage, all the moisture must be taken out; this must be done before the important subsequent operation—"impregnation"—can take place. The cables are put in large tanks and the moisture taken out by producing a high vacuum, the tanks being kept at a high temperature. When this is done, the hot compound is let in on the cable and forced entirely through the paper. A lead sheath fitting tightly over the paper, is next put on, the series of electrical tests made and the cable is ready for shipment.

Magnet wire insulated with silk or cotton is an important product of this company. It is manufactured to very rigid specifications, as to limits of size, thickness of covering and finish. Cotton magnet wire is usually furnished with two coverings of very fine cotton wrapped in opposite directions, although single and triple wrap is sometimes called for; the standard for all silk magnet wire is a single covering, although comparatively small amounts are made in double or triple wrap.

In this covering for silk magnet, the very finest Italian Tram silk is used; the best long fibre combed Sea Island cotton is used in the cotton cover. The thickness of the single silk covering is about one one-thousandth of an inch, and that of single cotton two one-thousandths of an inch, and in order to get the very thin cotton coverings called for, cotton as fine as 160's is used. The wrappings of silk or cotton are applied in a specially constructed machine whose heads revolve at a very high speed. The tube of cotton is mounted on this head, and, as the wire is pulled

Fig. 9—Lead presses.

through it by the capstan, the material is wrapped evenly, smoothly and continuously over the entire surface of the wire. After going several times around the capstan, it is taken up by the reel or spool, in which condition it is sent to the inspection department.

Switchboard and telephone cords, a great variety of flexible cords including lamp cord, counterweight, elevator light and bell, annunciator wire, etc., are manufactured and each requires its own special treatment. It is beyond the scope of this paper to go into the details of the manufacture of each of these types, the aim being to give only a general idea of the products and methods of manufacture, rather than to go too fully into detail.

Moonlight Schedule for February, 1913

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
Feb. 1	5 40	Feb. 2	6 30	12 50
2	5 40	3	6 30	12 50
3	5 50	4	6 30	12 40
4	5 50	5	6 30	12 40
5	5 50	6	6 20	12 30
6	5 50	7	6 20	12 30
7	5 50	8	6 20	12 30
8	5 50	9	6 20	12 30
9	5 50	10	6 20	12 30
10	6 00	11	6 20	12 20
11	9 20	12	6 20	9 00
12	10 30	13	6 20	7 50
13	11 40	14	6 10	6 30
15	0 50	15	6 10	6 20
16	2 00	16	6 10	4 10
17	3 00	17	6 10	3 10
18	3 50	18	6 10	2 20
19	No Light	19	No Light	
20	No Light	20	No Light	
21	6 10	21	8 10	2 00
22	6 10	22	10 00	3 50
23	6 10	23	10 40	4 30
24	6 10	24	11 50	5 10
25	6 10	26	1 10	7 00
26	6 20	27	2 20	8 00
27	6 20	28	3 30	9 10
28	6 20	Mar. 1	4 30	10 10
	Total		.....	215 30

Apparatus for Improving Power Factor

By Mr. Miles Walker, M.I.E.E.*

To describe all the apparatus which has been invented and developed for this purpose and for kindred purposes during the last few years would be a very great task, and it is doubtful whether one author could do justice to these new machines, intimate acquaintance with any one of which can only be possessed by the particular designer who has developed it. This paper will be confined to a short statement of the principles involved and a description of the phase-advancer built by the British Westinghouse Company.

We may look at the cause of the lagging current in the following way: The energy stored in any magnetic field consists of two factors:

(a) The total flux;

(b) The magneto-motive force driving that flux.

Now the total flux when created at a certain frequency produces a certain back e.m.f. in each turn encircling it and the magneto-motive force requires for its production a certain number of ampere-turns. Thus, from the two factors—flux and magneto-motive power—we arrive at certain factors necessary for the production of the alternating magnetic field at any given frequency. These factors are:—

1. Electromotive force per turn;
2. Number of turns;
3. Amperes per turn.

Grouping 1 and 2 together, we arrive again at two factors—volts and amperes—whose product represents the idle component of the power required to generate all the alternating fields in the distribution system.

The higher the frequency of the supply, the greater will be the idle component of the power required to produce the alternating field. If the field can be produced by a rotating magnet (as, for instance, in a synchronous motor) excited by continuous current, the frequency of the current being zero, no idle component is necessary. Indeed, by supplying more continuous current turns than are necessary to produce the magnetic field in any particular machine, it is possible to create in the system a leading current, which will compensate for a lagging current in another part of the system. The field current in the magnet of an alternator may be said to have two functions:—

1. To produce the magnetic field which generates the electro-motive force in the alternator itself.
2. To supply an additional magneto-motive force, which by means of a wattless current is communicated to all the machines in the system that have not got continuous current excitation themselves.

If we are to reduce the wattless current we must either use machinery requiring weak magnetic fields or we must provide independent means of magnetising the fields. A modern transformer does not take a large wattless component in proportion to its output, because though the total flux generated may be great, the magneto-motive force required to produce that flux is very small. An induction motor, however, having necessarily an air-gap and coils of considerable magnetic leakage, has in it a magnetic field which requires a wattless component of 25 to 30 per cent. of the kilovolt-ampere rating of the motor. For this reason the induction motor is the main cause of low power-factors on our alternating-current systems.

If now the magnetising current of an induction motor can be supplied at the frequency of the slip (say, one cycle per second) instead of at the frequency of supply (say, 50 cycles per second), the wattless magnetising kilovolt-amperes are very much reduced.

In 1895, M. Leblanc proposed to supply the magnetising current to the rotors of induction motors and generators by means of special exciters, which consisted of commutating alternating-current generators whose magnets were excited by the rotor currents.

The method can be most easily followed when applied to a rotor wound for two phases. In Fig. 1 Wa and Wb represent the windings in two phases of the rotor. Ea and Eb are the armatures of the two exciters. These exciters may be made like single-phase series motors, provided with compensating windings. The current from the phase Wa passes from the collector ring through the compensating winding Ca through the armature Ea, and then through the field Fb of the exciter in phase B, and thence to the star-point O. The current from phase Wb passes through the compensating winding Cb, through the armature Eb, and then through the field Fa of the exciter in phase A and to the star-point. The induction motor can be started up by means of the resistances Ra, Rb, the exciters being short-circuited. When the motor is running, the armature Ea has generated in it an e.m.f., which is in phase with the current in phase B; and if the polarity of the poles is properly

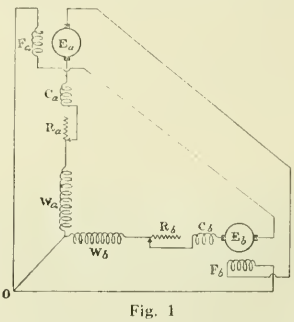


Fig. 1

arranged this e.m.f. will be leading 90° on the current in phase A. Similarly the armature Eb can be made to supply an e.m.f., whose phase would lead by 90° on the current in phase B. This has the effect of making the currents in the rotor take up a phase in advance of the e.m.f. produced in the rotor; so that not only can the magnetic field of the induction motor be created by the rotor currents, but the current in the stator can be made to lead on the e.m.f. of the supply. The clock diagram, Fig. 2, shows the phase relations between the various currents and the e.m.f.'s. OWa represents the e.m.f. generated in the rotor circuit by the slip. WaDa represents the e.m.f. generated in the armature of the exciter. DaCa represents the drop due to the impedance in various parts of the circuit and CaO represents the drop in the resistance of phase A of the rotor winding. The current in phase A has, of course, the phase position OCa; thus it is leading on the e.m.f. OWa, the clock diagram being supposed to be rotating in the direction indicated by the arrow. It will be seen that the line WaDa is parallel to the line OCb, because the current OCb excites the armature in phase A. Similarly the e.m.f. WbDb is parallel to the line OCa. By increasing the speed of the exciters, the e.m.f. at right angles to the current can be increased more and more. It will be seen, however, that with

*Presented before the I.E.E.

the connections made as shown in Fig. 1, the more the rotor current leads the more acute becomes the angle DWO, i.e., the e.m.f. generated in the exciter comes to have a greater component opposing the e.m.f. generated in the rotor circuit, and this has the effect of increasing the slip of the motor.

The paper above referred to described certain experiments made with independent exciters, after the manner indicated in Fig. 1.

The main objection to the method as described in Leblanc's early patent, is that it requires two or three exciters, and as the currents to be dealt with would in general be large, the cost of these exciters becomes excessive. Leblanc has described an exciter which embodies in one machine all phases, and is of a very simple nature. This is illustrated in Figs. 3 and 4, which show two pole armatures, one arranged for 2-phase and one for 3-phase.

The armature is made like an ordinary drum-wound continous-current armature. It is surrounded by a simple ring of laminations, having inwardly projecting poles, but without any field windings. The notches in the field are to

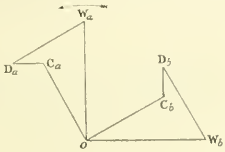


Fig. 2

aid commutation. If such an armature as illustrated in Fig. 3, be provided with four brushes, placed at 90° to one another on the commutator and connected to the four slip rings of a 2-phase rotor of an induction motor, and is run at a speed which is high as compared with the frequency in the rotor circuits it will have the effect of producing leading currents in the rotor. The beauty of this exciter is that the armature currents themselves excite the field, and produce a flux in the armature which is in such a phase as to generate an e.m.f. in each circuit, exactly at right angles to the current carried by that circuit. For, at the instant when the maximum current is going into the armature by brush A_1, and out at brush A_2, the armature will be magnetised with one pole at the top and another pole at the bottom, so that no e.m.f. is generated in phase A, but a maximum e.m.f. is generated in phase B. Thus we see that the e.m.f. in any phase is always at right angles to the current in that phase. The question whether the e.m.f. leads or lags behind the current depends only on the direction of rotation. Such an exciter can be built for three phases as illustrated in Fig. 4, and would be much cheaper to build than three separate exciters. By proper design, and by using carbon brushes, the commutation can be made sufficiently good; but in view of the fact that the rotors of induction motors of large power usually carry very heavy currents, the commutator of such an exciter say, for a 1,000 h.p. motor, would be of considerable dimensions.

A. Scherbius, in a recent letter to the Electrician, gave an illustration of a phase-advancer of this type made by Messrs. Brown, Boveri & Company, capable of bringing to unity power-factor a 600 h.p. motor. The overall dimensions of this set are 50 inches by 22 inches by 25 inches, and its weight 750 lbs. The cos curves of a 400 h.p. 32 cycle motor running at 160 revs. per minute both with and without the advancer are given in Fig. 5.

It will be recognised that the stationary iron frames in Figs. 3 and 4 are not really necessary, except in so far as they may reduce the magnetic reluctance of the magnetic circuit when an open slot-winding is used on the armature. If a winding with closed slots is used, the magnetic circuit may be wholly within the armature. While the armature rotates, the field remains stationary as long as a continuous current is supplied to one set of brushes. If currents slowly alternating, such as those from a rotor winding, are supplied, the field slowly revolves in space while the rapidly revolving armature conductors cut across this field and generate the necessary leading electromotive forces. An exciter of this kind having no external field, and made by Messrs. Brown, Boveri & Company, was recently illustrated in the Electrician. The use of the external frame, however, seems to possess several advantages; it enables open slots to be

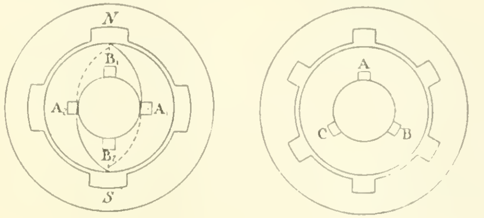


Fig 3. Fig 4

used on the armature, and by fixing the position of the field independently of the currents carried by the armature enables the commutation to be performed in a thoroughly satisfactory manner.

It should be pointed out that the main reason why the phase-advancer has a fair chance of commercial success is that it is a machine of small output in comparison with the amount of change of wattless load which it is capable of effecting when used in conjunction with an induction motor of suitable size. A phase-advancer of only 30-kv.a. capacity is capable of changing the power-factor of a 1,300 k.v.a. motor from 0.88 lagging to 0.95 leading. That is to say, the motor instead of requiring to be fed with lagging wattless current to the amount of 600 k.v.a. will relieve the generators supplying the system of a wattless load of 400 k.v.a., making a total change in the wattless power of 1,000 k.v.a. to the good. The reason is that the phase-advancer stands in the

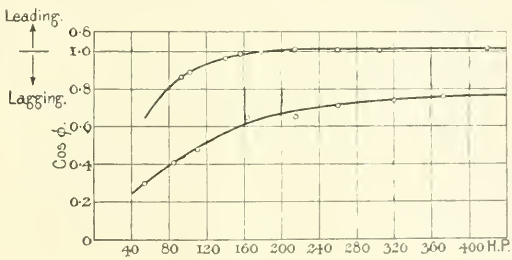


Fig 5

same relation to an induction motor as an exciter does to a synchronous motor. An exciter of comparatively small capacity can over-excite a synchronous motor so as to make it supply a wattless load fifty times as great, measured in k.v.a., as the rating of the exciter. Now if for some mechanical work a large induction motor must be employed, the extra cost of making that motor run at unity, or even at a leading, power factor is not very great. It is merely a question as to the cost of an advancer whose rated output is some 3 to 6 per cent. of the rating of the motor, and the cost of a 3-phase double throw switch for putting it in and out.

The armature of the phase-advancer may either be of the open-circuit star type or of the closed circuit type. Both

kinds of armature commutate well. The first (Fig. 6) is suitable when the current to be collected on the commutator is very great and the voltage to be generated is small, say not more than 15 volts. It enables a very wide brush (extending over 0.7 of the pole pitch) to be used. The second

Fig 6

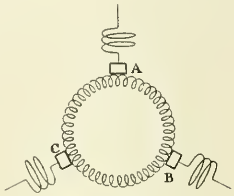


Fig 7

type (Fig. 7) is suitable when the current is not very great and the voltage is higher.

In designing the rotor of an induction motor we have a fairly free hand in the choice of the standstill voltage. We may choose a low voltage and a large current, or a higher voltage and a smaller current. It is usual even on very large motors to keep the standstill voltage below 1,000 volts so as to avoid excessive stresses on the insulation; but it is probable that if phase-advancers are much used in the future the standstill voltage of the rotors of very large motors will be somewhat increased. There is no difficulty in insulating the revolving winding to withstand considerably higher voltages particularly as the running voltage is exceedingly low.

The cases that will be found most suitable for the addition of phase-advancers to induction motors are those where the motors are intended to run continuously in one direction throughout the greater part of the day. If a motor is intended to be started and stopped frequently, or reversed, then it is not suitable. Large induction motor-generators, whether the continuous current load is steady or not, might very well be fitted with phase-advancers to improve the power-factor of the system to which they are connected; also large induction motors driving fans for mines or driving other machinery which runs continuously in one direction.

(Concluded in February 15th issue)

Report on Underwriters' Laboratories

Their Formation, Scope of Operations and Effect on the Importation of British Goods into the Dominion of Canada

By Mr. C. Hamilton Wickes

The U. L. C. is located in a specially-designed building at 207 East Ohio Street, Chicago, Ill., with a plant and equipment valued at £20,000. It was granted a charter in November, 1901. The U. L. C. has one Branch Testing Laboratory (recently erected) at New York.

The establishment of the Underwriters' Laboratories, Chicago, was brought about doubtless by the great and disproportionate destruction of property by fire throughout the United States, and in consequence of the heavy losses that resulted, which fell on the insurance companies (fire underwriters).

It should be understood that the problem the insurance companies had to solve, in view of the conditions prevailing throughout the United States, and it may be said North America, was to evolve some method which would tend to reduce the great danger existing of fire hazard and the consequent restriction of business. Among other difficulties appertaining to the position differing from the United Kingdom was:—(a) The common use of wooden buildings; (b) the great area of the territory; (c) the high voltage of the electric current transmitted by overhead wires, even through the main streets of their cities; (d) the large number of manufacturers, good, indifferent and bad, intent only on selling their products, in many instances to firms with little or no technical knowledge, who styled themselves contractors, architects, etc.; (e) the compelled employment of careless, indifferent and incompetent workmen; (f) together with the practical impossibility of obtaining anything like skilled inspection or supervision of the work, even in the towns.

To use the phraseology of "The National Board of Fire Underwriters (New York)," "it was found necessary to provide means for securing a correct solution of the problems presented by reason of the great and disproportionate losses by fire, and to bring to the 'user' the one best obtainable opinion on the merits or demerits of appliances in respect of fire hazard."

This is a high and proper ideal, but however great the necessity might have been for an institution of this character, that would not in itself necessarily have brought about the inception, nor given the U. L., Chicago, the power, and, practically, the absolute control, it exercises to-day over all articles, appliances, material or devices styled "articles for public utility," affecting fire hazard used in buildings throughout the country. It is due to the hearty support which came to be accorded as the value of the Laboratories' work became recognized by the insurance companies—British, American, German, French and Canadian—carrying on business in the North American Continent.

The Laboratories had quite a humble beginning, and I am informed that at the first they confined their attention to certain classes of electric material and fittings, e.g., the "National Electric Code" standards were first compiled in 1896-7 but their influence has steadily grown and they cover to-day (inter alia):—

(a) Machines and fittings which may be instrumental in carrying a fire, gas and oil appliances, electric fittings, wiring, conduits, fuses, etc. Machines and appurtenances used in lighting or heating chemicals.

(b) Fire extinguishers, automatic sprinklers, pumps, hand fire appliances, hose, hydrants, nozzles, valves, etc.

(c) Material and devices designed to retard spread of fire, structural methods and materials, fire doors and shutters, fire windows, etc.

President of the Corporation, chairman of the Board, Mr. Henry C. Eddy, of Chicago (resident secretary, Commercial Union Assurance Company, and the Palatine Insurance Company); secretary and treasurer, Mr. Wm. H. Merrill, Chicago. The board of directors consists of 10 other gentlemen, of whom four represent British companies, and six American insurance companies.

There are, therefore, including the two British insurance companies represented by the president, six British and six American companies represented on the Board of the U.L.C.

The board constitutes the governing authority, handles its finances, and directs all matters of policy, including ap-

pointment of "the Council," the manager and members of the engineering staff.

Technical Staff of Laboratories

The manager is Mr. W. H. Merrill; the chief engineer, Mr W. C Robinson (who recently visited England), and there is a staff of over 50, which includes consulting, electrical, gas and oil, and chemical engineers, with numerous assistant engineers, a superintendent of labels, cashier, etc.

The Council

A body having important functions connected with the U. L. C is the "Council." The members are nominated by the "board of directors of the laboratories," as stated above. The Council consists of gentlemen who, either in their individual or corporate capacity, have the requisite knowledge or employ technical men on their staff, able to advise them in respect of the Reports forwarded for their consideration by the Underwriters' Laboratories. It will be noted that among the members of the council are Mr. W. H. Merrill, manager of the Laboratories, Mr. W. C. Robinson, his chief engineer, and Mr. Hadrill, who, as secretary to the Canadian Fire Underwriters' Association, has under him quite a number of technical men.

It is by the Council that the technical work at the Laboratories is supervised, and it is not until the Reports are approved by the Council that they are promulgated. The Council numbers 22.

The technical staff, having carried out the experimental work and tested the merits or demerits of each article, device, appliance, material or system submitted, with a view to their bearing upon fire hazard, proceed to draw up a detailed and extremely elaborate report. This report is forwarded to each member of the Council, and in due course is returned to the Laboratories with such endorsements, amendments or criticism as each member of the Council may consider necessary or advisable. The points raised, if any, are then printed and again circulated to all the members until a decision has been obtained. The final decision, whether favourable or otherwise to the article, device, appliance, material or system, is bulletined, that is, a summary of the Laboratories' Report is distributed on printed cards, filed, according to classification, to the various insurance organizations and companies subscribing to or co-operating with the Laboratories' work. A copy of the bulletin (printed card, presumably) and the detailed report is furnished to the applicant, who originally submitted the article for inspection.

There can be no doubt that the greatest care is taken in the experimental work and tests carried out by the Laboratories, and equal care in the preparation of the Reports in its final shape before any article, appliance, material, device or system receives the final approval of the U.L.C.

It may be observed here that cabinets containing these cards are maintained at the offices of the principal Boards of Underwriters and inspection bureaus in the United States and Canada and a few in other countries, at many of the general offices of insurance companies, certain municipal departments, and at the local offices of the Laboratories in the larger cities. There are also "lists" compiled by the Laboratories, which are freely distributed, of "approved and permitted devices," with the manufacturer's name.

Specifications, Rules and Requirements Under Which the Experimental Work is Carried on at the Laboratories

The specifications under which the experimental work is carried on by the technical staff of the U.L.C. are based upon the rules and requirements of the National Board of Fire Underwriters, New York, as "recommended by the National Fire Protection Association, New York." This is the present practice; previously the various Committees acted solely under the direction of insurance authorities. These have been transferred to the National Fire Protection Associations, in which "all interests are represented."

Many of "The Rules and Requirements" referred to above are printed in pamphlet form. Printed copies of these pamphlets are filed with the Board of Trade.

Inspection at Manufacturers' Factories and Labelling

The article, appliance, device, material or system submitted to the U.L.C. having been tested and approved, the Laboratories step in and say, "before the article may be marketed it must come under our supervision before we will issue a label or tab to indicate that the same has been inspected and passed by us."

The older form of supervision is. A contract to be entered into between the manufacturer and the U.L.C. whereby the maker agrees to construct appliances in exact duplicate of the sample approved, and to pay a certain fee annually, ranging from \$5 to \$30.

The second or newer form of supervision consists in inspection by Laboratory engineers of the devices and materials at factories, and the labelling of standard goods by stamps, transfers, or metal labels, whereby they can be recognised wherever found. The cost of the service is partially defrayed by charges made for the labels. These vary according to the nature and extent of the inspection needed.

A "schedule" of the charges for labelling certain "standard goods" will be found, as a guide, in Appendix "F," together with specimen lithographed labels. The sale of these labels includes the following costs:—

1. Cost of manufacturing the label.
2. Salaries and expenses of agents and inspectors of branch offices.
3. Salary of supervising engineer at home office.
4. Salary and travelling expenses of special agent.
5. Overhead charges.

Inspection

Throughout the United States the U.L.C has officers who inspect and pass articles, appliances, devices, material or the system installed in any building which the owner requires to insure. It is these inspectors who accept or refuse articles because they have not the U.L.C. label or tab. So far as the Dominion of Canada is concerned, the inspectors are appointed by the Canadian Fire Underwriters' Association. The contention is that the inspection departments of insurance organisations find it easier to pass upon an installation in which nothing but labelled material is used—and this it is contended tends to a better class of installation.

It should not be inferred that the inspector's duty is confined to checking the labelled material. It is important from the manufacturer's point of view, but from the insurance companies' standpoint the inspector has to see that the workmanship of the wireman and electrician, for example, is good, and that the work has been carried out in accordance with the Rules and Regulations dealing with the design and layout of the installation. Generally, his skill in judgment and experience is called for in interpreting these rules and requirements in accordance with the particular kind of building which he is inspecting for the time being.

An important factor is the question of danger to life "should a fire occur." This, I fear, is not taken into account. In fact, I understand it cannot come within the inspector's consideration, so long as the installation complies with safeguarding fire hazard.

Cost of Experiments and Tests, with Some Particulars to Intending Applicants.

Blank forms for use in making applications for tests will be furnished on request to the U.L.C., 207 East Ohio street, Chicago, although no fixed form of application is necessary. A letter addressed to the Laboratories, setting

forth all the claims made for the article, enclosing the preliminary fee, and giving notice of shipment, is sufficient. All shipments should be consigned to Underwriters' Laboratories (Inc.), 207 East Ohio street, Chicago. The latter are not responsible for damage in shipment, and cannot undertake to repair damaged goods, or to assemble or erect apparatus shipped in parts.

Freight or express charges must be prepaid.

Goods from the United Kingdom should be shipped in bond.

It is understood that Customs charges, if any, are paid by the Laboratories.

It will be noted in the particulars given below that in respect of articles coming within Groups A to E, there is "a maximum" cost, which will not, under any circumstances, be exceeded.

The Laboratories will, on receipt of an application accompanied by description of the article to be tested, advise as to necessary charges in each case, and in all instances where the costs do not aggregate the amount of the preliminary fees, the balance will be returned to the applicant, to whom, at the conclusion of the "test," a full and detailed account is rendered, and, as stated above, a copy supplied of the Bulletin, as well as the detailed Report. The fees are as follows:—

Group A.	Preliminary fee, $100.00	Total cost not to exceed $250
" B.	" " 50.00	" " " " 10
" C.	" " 25.00	" " " " 7
" D.	" " 10.00	" " " " 5
" E.	" " 5.00	" " " " 2

Group F.—Under this group are classified experimental work and researches covering subjects or appliances for which standard requirements are not accepted. The amount of preliminary fee is $100, and bills are rendered monthly as the work proceeds.

The various articles, appliances, materials, devices and systems thus far tested (1909), are classified into the various Groups A to E.

General Remarks

The parent body of the Underwriters' Laboratories, Chicago, is "the National Board of Fire Underwriters, New York," under whose "general direction" the work at the Laboratories is carried on. In practice, however, the power of the parent body may be said to be vested in The Board of Directors. The chief financial support is derived from the parent body, the Laboratories not being in business for profit; it is not believed that it has made any profit; the U.L.C. is a corporation for fire protection and not for profit. The insurance companies are the largest contributors. They receive regular appropriations from the National Board of Fire Underwriters, the Western Insurance Union, and other organisations, as well as from a number of individual companies who desire special service in the matter of reports.

It will be noted in going through the Report that the Rules and Requirements are adopted by the N.B. of F.U. (N.Y.) under the recommendation of the "National Fire Protection Association, of New York." This important Association, whose president for the year 1912-13 is Mr. H. L. Phillips, of 5 Haynes street, Hartford, Conn.; vice-president, Mr. G. M. Robertson, of San Francisco; and secretary-treasurer, Mr. F. H. Wentworth, 87 Milk street, Boston; with a chairman and executive committee of 15 gentlemen, five of whom retire yearly, dates from the year 1896-7, about which time a "National Conference" was held at New York.

Standard electrical rules were drawn up as the result of the united efforts of the various insurance electrical, architectural and allied interests; the National Conference was disbanded, the work (of the Underwriters' National Electrical Association and of the National Conference) being taken over by the National Fire Protection Association. The following Associations, formerly members of the National Conference, are represented on the Electrical Committee of the N.F.P.A.:—

American Electric Railway Association.
American Institute of Electrical Engineers.
Associated Factory Mutual Fire Insurance Company.
National Board of Fire Underwriters.
National Electric Light Association.
National Electric Contractors' Association.
National Electrical Inspection Association.

The work of the National Fire Protection Association, of New York, is directed by Special Committees, of which there are no less than 29, and covers subjects as wide apart as "safe and vaults" and "hose," "electric railway, light and power properties," "automatic sprinklers," "fire pumps," "gravity tanks," "mine fires," "laws and ordinances," "signalling systems,", etc.

The report of proceedings of the sixteenth annual meeting held at Chicago, May 14th, 15th and 16th, 1912, accompanies this report, and The Year-Book of the National Fire Protection Association (September, 1912) gives the membership, from which further detailed particulars can be ascertained.

The membership of the N.F.P.A. consists of four classes: Active, who only have the power to vote—membership 102, with a subscription of $15 per annum; Associate, over 1,200 members, annual subscription $5; Subscribing, over 600 members, annual subscription $5; Honorary, 3 life members.

The Active class comprises 102 members, including (1) National Institutes, Societies and Associations interested in the protection of life and property against loss by fire, (2) State Asociations, whose principal object is the reduction of fire waste, (3) Insurance Bodies and Insurance Associations having primary jurisdiction. Out of these 102 Active class members 82 are Insurance Companies (fire underwriters) or Associations connected therewith, such as inspection bureaus, actuarial bureaus, etc. Twenty may be styled business associations. Among the latter are the following:—

American Institute of Electrical Engineers, New York.
American Institute of Consulting Engineers, New York.
American Electric Railway Asociation, New York.
American Institute of Architects.
American Warehousemen's Association, Pittsburg.
Canadian Manufacturers' Association.
Electrical Supply Jobbers Association, Chicago.
National Association of Manufacturers, New York.
National Hardware Association, Philadelphia.
National Paint, Oil and Varnish Association, New York.
National Electric Light Association, New York.
National Electrical Contractors' Association, Utica, New York.
National Association of Sheet Metal Contractors Philadelphia.
Canadian Fire Underwriters' Association, Montreal and Toronto.
Mainland Fire Underwriters' Association, Vancouver, B.C.
New Brunswick Board of Fire Underwriters, St. John, N.B.
Nova Scotia Board of Underwriters, Halifax, N.S.
Western Canada Fire Underwriters' Association, Winnipeg.

Canadian Fire Underwriters' Association

Offices, 535 Coristine Building, Montreal. Secretary, Mr. A. W. Hadrill. At the present time 60 insurance companies are members of this Association. I might mention that while this is by far the most important of the Underwriters' Associations in the Dominion of Canada, there are four others, as stated above.

Of the present list of 60 members of the Canadian Fire Underwriters' Association 28 are British, or their capital is

controlled in Great Britain, 19 are American, 12 Canadian, 1 French.

The British insurance companies headed by the Royal Insurance Company—together underwrite some 55 per cent of the total fire risks in the Dominion of Canada, and therefore occupy an important position in the Associations of Fire Underwriters throughout Canada. Their position and influence in the United States of America are also considerable.

British Manufacturers v. The Operations of the Underwriters' Laboratories, Chicago

The experimental work carried out by the Laboratories at Chicago, their method of drawing up reports and labelling approved articles, followed by inspection, already dealt with, is no doubt advantageous, not only to the fire insurance companies, but also to the American manufacturer carrying on business in the United States. I would also be prepared to concede that the U.L.C. are desirous of not placing difficulties in the way of the foreign manufacturer (which includes British) utilising the facilities offered by them. It is nevertheless an intolerable state of affairs that the British manufacturers, as well as the Canadian, should be compelled to send samples and particulars of their goods to a foreign corporation, to be "approved or rejected," before they are able or permitted to do business in a portion of the British Empire, namely, the Dominion of Canada.

I will briefly outline some of the more salient points which operate to the disadvantage of the British manufacturer desiring to do business in the Dominion.

1. The British manufacturer has to incur the expense of packing and freighting the articles forwarded to the Laboratories at Chicago, with the consequent delay. Whether the article is approved or otherwise, he is still unable to ship the goods to the Dominion, as no means exist of examination and labelling at the factory in the United Kingdom, which the Laboratories properly insist on.

The suggestion has been put forward that such goods shipped to Canada might be examined and labelled, as the Laboratories require, at "the port of discharge" in the Dominion. The objection to this course is that besides the expense of maintaining a qualified inspector, there is a real risk incurred of the goods not being passed (rightly or wrongly), with consequent loss to the British shipper, in all probability followed by the return of the goods to the United Kingdom, with the great expense thereby entailed.

2. The Laboratories are officered by consulting and other engineers expert in regard to various lines, as has been shown. It may be conceded that they exercise a wise and discriminating care in the carrying out of their duties in regard to American manufacturers, but when it comes to experimenting and testing articles of British or European manufacture, devised on different lines and manufactured to standards other than the rules, requirements or standards laid down by the N.F.P.A., under which the Laboratories carry out their work, the technical staff, without any experience in regard to the reliability of the article submitted in actual use, not infrequently find themselves obliged to withhold their authorisation. To this the British manufacturer very properly objects, and he feels the more indignant when he is aware that his manufactures in every way meet the more stringent requirements in other parts of the world. I think he should be supported in this objection unless, indeed, we are prepared to concede that the United States engineer is the repository of all the wisdom of the world in regard to every class of article, appliance, system or device dealing with fire hazard, which has been, or is to be, invented in the world.

3. The System of Inspection amounts, in practice, to the inspectors appointed seeing that certain labels or tabs are appended to articles. In time, no doubt, they become more or less experienced, but the idea is to throw the responsibility of the real inspection of the article on the Laboratories at Chicago. The inspector is, apparently, expected to work on rule of thumb lines. He is, I gather, not expected to do otherwise than see that labels or tabs of the U.L.C. are properly attached to the article, device or system to be installed in the various buildings.

The tendency is for this attitude to become accentuated; pressure has been, and is being, exercised by the Laboratories on the Canadian Fire Underwriters Association not to allow any article to be installed, within their jurisdiction, without the Laboratories' label or tab. In Winnipeg the use of the Laboratories' label has been made the rule by the Western Canadian Fire Underwriters' Association. In Montreal they have been, I am informed, not quite so strict up to the present, but Mr. Hadrill, secretary of the Canadian Fire Underwriters' Association, confesses that their inclination is to draw the line tighter and only permit goods with the label or tab of the U.L.C. to be utilised.

I might mention in this connection that complaints, difficult to prove or disprove, are made by British manufacturers or their representatives of prejudice on the part of inspectors against British goods, and of the necessity, as they allege, of gaining the inspector's goodwill by means of a douceur in order to facilitate the passing of material submitted. This difficulty is probably in respect of articles without the customary Laboratories' label or tab.

I would refer to what has been stated before, and that is, that the Inspector's skill and judgment is called for in regard to the application of the Rules and Requirements, for example, the workmanship of the wireman or electrician generally regarding the design and lay-out of the installation, taking into consideration the particular kind of building in which the work is being carried out.

I would also repeat that I understand there are no regulations to guide the Inspector with reference to "danger to life" in the event of fire breaking out; in other words, that the wiring and other matters which he inspects are looked at purely and only from the point of view of fire hazard to the building, without regard to the matter of hazard against life (shock fatality, and so forth).

4. It will be readily recognised in view of manufacturing and other Mercantile Associations which are "active" members of the N.F.P.A. and the American composition of the Council, and the experience practically based on American practice, so far as I know it, of the technical staff of the Laboratories, that the introduction of new methods or fresh standards might meet with considerable opposition, and, in addition, there would probably be a natural reluctance to give a definite finding in respect of articles which may be practically unknown either in respect of their form or in regard to their reliability.

5. It should be mentioned that particulars are filed at this office of instances in which the parties alleged discrimination and unfair treatment, in respect of both electrical and other classes of goods submitted to the Laboratories. Personally, I find it hard to believe that any discrimination has been shown beyond what may be easily explained by the composition of the Laboratories, the council and the associations under whose direction the work is carried on. An incident which happened in Montreal in August last illustrates another phase of the difficulty met with by British goods sent to Canada. A sample of wire was sent to the Chief Electrical Inspector in Montreal, and I have a copy of his letter in which he stated, "the samples of wires enclosed are acceptable." In Toronto the following month, in regard to the same article, I have a copy of the original letter from the Chief Electrical Inspector, in which he writes as follows:—"We beg to advise that neither of the two pieces comply with new code requirements." Of course, in the

latter instance, the reason was that the wires were not labelled and tabbed with Laboratory labels.

The above is a sample of a number of similar instances which it can be readily understood cause considerable heart-burning to the parties injured, particularly where the goods are of high class, and, in fact, manufactured to a much higher standard than is required by the Laboratories themselves. Nevertheless, the inspector must reject them in many parts of Canada if they have not evidence of the approval of the U.L.C.

The chief engineer of the U.L.C. was in England as recently as August-September last, and saw the managers and representatives of a number of British insurance companies while staying in London—Mr. Robinson having also visited Manchester, Liverpool and Birmingham, in accordance with Mr. Merrill's desire that he should endeavour to ascertain the attitude of English manufacturers towards the Underwriter's Laboratories. I will close my remarks on this heading by an extract from a letter from Mr. Robinson, after his visit to England, to Mr. Merrill, manager of the U.L.C., Chicago:—

"As a result of all my conferences in England with manufacturers, insurance men, and others, I am of the belief that in a considerable number of cases English manufacturers will be likely to object to sending their products to any authority in the United States in order to secure insurance approvals for Canada.

"The following was presented for the consideration of the Insurance Managers, and was discussed to some extent:—

"1. The possible desirability of in some way establishing the Underwriters' Laboratories in England in order to facilitate its business with English manufacturers and avoid misunderstandings relative to the approval of goods shipped into the United States and Canada.

"2. The question of what connections could be made and the best method for the conduct of the business in case it was considered desirable to establish the Underwriters' Laboratories in England."

"I am of the opinion that there is a genuine desire on this side, both by the Canadian Fire Underwriters' Association and the U.L.C., to remove any cause for complaint which the British manufacturer labours under, but the insurance companies are not going (I think rightly) to permit uninspected goods to enter and be used from the U.K. or elsewhere, because they consider the risk is too great; an alternative method, therefore, safeguarding the insurance companies operating in Canada, should be evolved. The solution might be by—

"1. A laboratory in Canada on the lines of the U.L.C.

"2. A purely British laboratory, referred to at the end of Mr. Robinson's letter as 'an independent agency.'

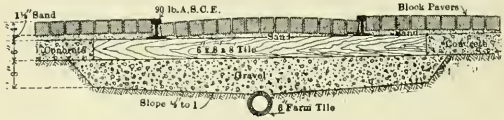
"3. A laboratory in England, to be practically an offshoot of the U.L. Chicago—run on similar lines, utilising the experience gained at Chicago, employing equally competent but British consulting and technical engineers. 'The article,' approved by label or tab, to be accepted by both the British and Chicago Laboratories. The same system of careful experiment and tests to be followed by careful consideration of reports before they are issued, and the adoption of the same or a similar system of 'labelling and tabs,' accompanied by some similar system of inspection.

"I am of the opinion that the last, No.3, would be to the advantage of the British manufacturer (No. 1 is open to many of the objections raised against the Chicago Laboratories); it would throw open to our British manufacturers not only the Canadian but the American market (see Mr. Robinson's letter), as the labels or tabs would carry equal consideration by inspectors throughout North America. Moreover, the policy should be extended, I believe, and made operative in Australia, New Zealand, South Africa, India—in fact, throughout the Empire, wherever British insurance companies operate and are in a position to insist on its adoption."

I venture to believe that, if our leading manufacturers are wise, they will join with the insurance companies and contribute towards the initial cost of starting such a laboratory and by annual subscription assist towards its upkeep. An understanding between our manufacturers on the one hand, and the insurance companies on the other, should lead to the happiest results. It should bring about the extension of the trade to British manufacturers of articles, appliances, materials, devices or systems dealing with fire hazard in the oversea markets, and be of advantage to British insurance companies in the direction of reducing the risks of "fire hazard."

New Type of Track Construction

The Illinois Traction Company has recently developed a type of track construction in pavements which includes several novel features and which are described in a current issue of the Electric Railway Journal. A section of this new construction is shown in the illustration. It was designed



for both creosoted block and brick pavement and its advantages are found in the method of handling the pavement between the tee-rails. The section was designed for 90 lb. A.S.C.E. rails on 6-in. x 8-in. x 8-ft. wooden ties with a 6-in. concrete foundation under the pavement. By employing a template, a sand cushion, as shown, is formed between the rails and gives a crown at the centre equal to the height of the ball of the rail, so that no special filler block in the pavement is required. In case brick is used, a special brick may be purchased which is 3-in. deep, or the paving block, if the width is less than the depth, may be placed on its side. In case a creosoted block is used, the shallow block may be purchased at no additional cost over the price of the standard size; this is the cheaper method of paving between the rails.

Another feature is the method of preparing the subgrade. Usually the trench containing the ballast under the ties is rectangular in section, but in this case in order to provide drainage to a 6-in. tile, shown in the figure, which is installed at the centre of the trench, the sub-grade is sloped from the ends of the ties to the tile, ½-in. to 1-ft. The installation of farm drain tile with outlets in the centre of the track trench is advantageous in that the trench is usually below the sub-grade of the street.

Current Notes

The city of Moose Jaw will receive tenders for electrical machinery up to Monday, February 10th, for the manufacture, supply, delivery and erection of a 1,500 kw. steam turbine and generator. Specifications and general conditions may be obtained upon application to Electrical Superintendent Peters at Moose Jaw.

The municipality of the city of Regina, Sask., will receive tenders for track and trolley material for the Regina municipal railway system up to Monday, February 24th. Copies of specifications, schedules, delivery dates, form of contract and other particulars can be had upon application to H. Doughty, superintendent of the Regina municipal railway. Details of material required will be found in an advertisement appearing in another page of this issue.

ELECTRIC RAILWAYS

New Type Cars of the B. C. E. R. Co. — Both Stepless and Nearside Being Tried Out.

The British Columbia Electric Railway Company, have recently introduced a number of ideas, new to Canada in the way of rolling stock and accessories. The company have recently purchased, for experimental purposes, a "stepless" car similar to the well-known New York type and a

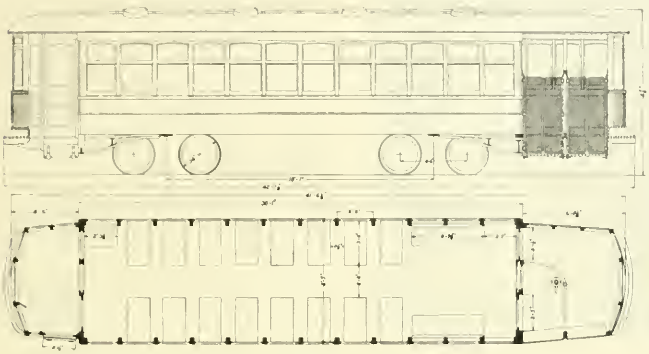


Fig. 1

"nearside" car, similar to those operated by the Philadelphia Rapid Transit Company. Though both double and single end prepayment cars are the standard type on the city lines of this company, the new designs were purchased to ascertain their relative merits and their adaptibility to Vancouver conditions.

Wire-mesh Gates

The line sketch shown herewith, Fig. 1, also illustrates another new idea, the folding wire-mesh gates installed on the rear platform of a number of the cars. The rear platform is divided by a railing, for separate entrance and exit, that extends from the bulkhead to a wooden post placed at the centre of the step and reaching to the hood. Two pairs of wire-mesh gates are hinged to this post and to the body and vestibule posts. They swing outwards and are operated by a simple lever system from the conductor's position. The front platform of this car, which is used for exit only, is provided with a folding step and inwardly swinging door operated in unison by the motorman, through a lever.

The "Nearside" Car

The "nearside" car is in every way a counterpart of those that have been adopted as standard by the Philadelphia Rapid Transit Company. It differs only in that it is arranged for left instead of right-hand operation, the former being standard on the B.C.E.R. lines.

The bottom frame, which is built entirely of steel, has side sills of 5-16-inch plate, 18 inches at the widest part, reinforced at top and bottom and vertically, at intervals, by light angles. At the forward end, upper trusses assist the knees in supporting the long platform. There are eight crossings made of light angles, forming powerful latticed trusses. The body bolsters are cast steel and are each designed to carry 21,000 lbs. at the center plate. The side posts, which are of ash, are tenoned into a yellow pine sill that is bolted to the lower angle on the sill plate. They are further secured by strap bolts that extend through the pine sill and angle, and by bolts through the vertical angles that are riveted to the sill plate. The wooden concave and convex side panels are sheathed with four sections of cold rolled sheet steel, and at the bottom is a 2 by 3-16-in. steel molding beveled on its top edge. Ash car lines, reinforced with steel, support the Brill plain arch roof.

The window system is the semi-convertible type, in which the sashes disappear in roof pockets. The absence of a rear platform greatly increases the seating capacity over the usual type of car, there being seats for 54 passengers, of whom 5 occupy a circular seat at the rear, the transverse seats, 32, the longitudinal seats at the left, 7, and those on the right side, 10. A greater width of both aisle and seat is obtained in the use of stationary-back transverse seats, having pressed steel pedestals with extensions to support the backs. From the forward bolster to the front platform the car floor slopes downwardly $1\frac{1}{2}$ inches, thereby reducing the step elevation. The interior woodwork is of cherry, all fittings of solid bronze, and the headlining of composition board. Stationary hand straps and signal push buttons are provided. The car is mounted on standard Brill No. 39-E single-motor trucks.

As in other "Nearside" cars that have been built, both the conductor and motorman occupy the front platform.

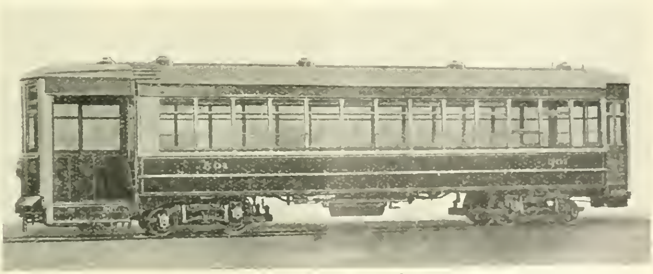


Fig. 2 —"Nearside" Car for Vancouver

The responsibility is definitely divided between the motorman and conductor. Opening and closing of doors and stopping and starting are entirely in charge of the former, while fare collection, issuing of transfers and announcing of streets are practically the sole duties of the latter, increasing crew efficiency and safe and prompt operation.

The principal dimensions of the "Nearside" car follow:

Length over corner posts	34 ft. $1\frac{3}{8}$ in.
Length over platforms	15 ft. 1 in.
Length of platform	7 ft. 6 in.

Centers of side posts	2 ft. 6 in.
Width over posts	8 ft. 5 in.
Extreme width	8 ft. 6 in.
From track to side sills	2 ft. 6¾ in.
From side sills over trolley boards	9 ft. 0½ in.
From floor to center of head-lining	7 ft. 11 1/16 in.
From track to step	13 15/16 in.
Step to platform	13 in.
Platform to floor	10½ in.
Seating capacity	54

Fig. 3—Interior "Nearside" Car, Vancouver

Type of trucks	Brill No. 39-E
Wheel base	4 ft. 10 in.
Diameter of wheels	33 in. and 22 in.
Weight of carbody less electrical equipment	18,180 lb.
Weight of trucks	10,040 lb.
Total weight less electrical equipment	28,220 lb.

The "Stepless" Car

The "Stepless" car is all-steel, with the exception of a few minor parts, not subject to strain, and some of the interior fittings. The steel bottom frame is built of two 3 by 3 by 5-16-inch angles which are depressed for the low-level floor between the trucks and converge slightly just ahead of each driver axle, where they are spliced to continuous angles of the same size, which are bent around the ends to form the bumpers and anti-climber supports. Directly under each door-opening, and extending slightly beyond, on both sides, an angle is set into the side sill, for reinforcement at that point, actually forming a built-up channel. There are nine crossings in the low level of the bottom frame, each consisting of 3-inch channels, of 4 lbs. section, placed back to back. The body bolsters are attached at the points where the side sills reach the high level over the trucks, and are built-up of 3½x6x3½x⅜-in. Z-bars, depressed between the wheels in order to preserve the low floor and retain the seat-cushions at about the same height throughout the car body proper. The stringers consist of 3 by 2 by ¼-inch angles, riveted to the crossings in sections. The outermost crossing on each end is connected to the body bolsters by two horizontal 4 by ¾-inch flat bars. Two 3-inch Z-bars are riveted to the depression in the body bolster and, diverging slightly, run through to the bumper. These Z-bars are bent upwardly at about 45 degrees near the driver axle, and then continue in the same plane as the side sills, forming the floor framing of the motorman's cab.

The side and roof construction is rather novel, in the use of No. 18 steel box posts, with brass corrugations for sash and curtain fixtures, and pressed-steel door frames, each consisting of two pressed steel sections, set against each other to form a continuous box around the top and sides of the openings.

The side posts and door frames are set in the side sills and riveted to them through angle reinforcement. Continuous pressed-steel top rails run from each side of the door frame to the corner posts and are riveted to the outer sides and tops of these and the side posts, as well as to foot flanges of the steel carlines. The carlines are cut from steel plates and are reinforced at the top and bottom with angles. Large holes, which in no way affect the strength, are cut into the plates, to accommodate the long pipes which are used for air storage purposes instead of the customary drum. Narrow poplar boards drawn over with cotton duck form the roof covering. Pressed steel belt rails, of box section, extend from the door frames to the corner posts and the upper framing along the sides and around the ends is covered with steel sheathing, making the superstructure an extremely stiff girder, in which the pressed-steel door frames, by virtue of their own form, and their connection to the longitudinal members, distribute the load between the car-ends and neutralize the breaking strains in the components of the structure.

Seats 51 Passengers

The interior finish is entirely of metal except the floor, which is laid with the usual yellow pine boards and maple mat strips, the headlining, which is composition board, and the double window sashes, which are wood, lined with brass stiles. The upper sashes remain stationary and the lower are made to raise. The seating plan provides for 51 passengers. In each half of the car are six reversible cross-seats, and two cross-seats with stationary-backs and a circular seat for nine persons between the stationary-back seats and the bulkhead. There is an additional folding seat for one passenger extending the width of one-half the entrance on the side that is not in use, the other half being occupied by the conductor's seat and change desk, from which all his duties may be performed. In lieu of hand straps, white enameled pipe stanchions supplement the grab handles on

Fig. 4—"Stepless" Car, Vancouver

Fig. 5—Interior "Stepless" Car, Vancouver

the seat backs, and push buttons are provided to signal the motorman. The bulk heads, in which there are three double drop sashes are the vertical extensions of plate girders that act as crossings in the bottom framing. The motorman's cabs contain the air compressor as well as the usual electrical equipment. In addition to a sliding door on the right side, with stationary sashes, there are four double-sash windows, the lower arranged to raise. In this type of car the motorman's seat is considerably higher than in usual cars and gives him the advantage of a good view ahead and to each side. The car is mounted on specially designed Brill No. 62-E single-motor trucks, in which the bolster is carried sufficiently low to accommodate the low floor over the trucks.

In the accompanying sketches Fig. 2 represents the exterior appearance of the nearside car, folding doors and steps at platform are operated by the motorman; an emergency exit at the rear is operated by the conductor; trucks are Brill No. 39-E single motor. Fig. 3 shows an interior view of the same car; seating capacity 54; circular seat in rear 5; transverse seats 32; longitudinal seat at left 10, at right 7. Fig. 4 shows the double sliding doors of the stepless car; these are pneumatically controlled by the conductor and act as a line switch and break circuit when open; special Brill trucks. Fig 5 shows the interior of the stepless; cross seats accommodate 32; 2 circular seats at the ends 18; folding seat at door 1; total 51; white enamel pipe stanchions supplement grab handles on seat backs; lower sash of windows raise full height; upper sash stationary. Fig. 6 shows the movable conductor's desk with fare box and register and folding seat for one passenger opposite entrance-exit; doors are controlled by foot-actuated air mechanism on stanchion holding fare box; the conductor's seat is high to afford view over passengers' heads.

The principal dimensions of the "Stepless" car follow.

Length over all	44 ft. 0 in.
Length over vestibules	43 ft. 0 in
Length of front platform	4 ft. 4 in.
Length of rear platform	4 ft 4 in
Centers of side posts	2 ft $5\frac{1}{8}$ in.
Width over sills	8 ft. $1\frac{1}{2}$ in
Width over posts	8 ft. $1\frac{5}{8}$ in.
Extreme width	8 ft. 3 in.
From track to side sills	$9\frac{1}{2}$ in.
From side sills over trolley boards	9 ft. $0\frac{1}{8}$ in.
From floor to center of head-lining	8 ft. 0 in.
Track of floor	$11\frac{1}{2}$ in.
Seating capacity	51
Type of trucks	Brill Special No. 62 E
Wheel base	5 ft. 0 in
Diameter of wheels	33 in and 21 in.
Size of journal	$3\frac{3}{4}$ x 7 in.
Type of motors	GE57—2-50 h.p.
Weight of carbody less electric equipment	17,500 lb.
Weight of electrical equipment	1,000 lb
Weight of air-brake equipment	1,400 lb.
Weight of trucks	9,640 lb.
Weight of motors	5,944 lb.

Both these experimental cars were purchased from the J. G. Brill Company, of Philadelphia.

The Morrisburg and Ottawa Electric Railway

Tenders have been called for ties, poles and steel rails; also for telephone equipment including the installation of the same. Prospects are reported very bright for the construction of this road at a early date, and it is the present intention to begin active work during the month of April.

Will Electrify Main Lines

The Grand Falls Power Company of Montana, has been given power to transmit under government regulations, sufficient power for the electrification of 450 miles of tracks of main line of the Chicago Milwaukee and Puget Sound railroad.

Fig. 6—Showing Conductor's position

Illumination

The Cooper Hewitt Quartz Lamp

The Quartz lamp represents an additional commercial development of the principles involved in the vapor lamp invented by Dr. Peter Cooper Hewitt. In principle, the difference between the standard Cooper Hewitt lamp and the Quartz lamp is only the greatly increased pressure of the luminous vapor in the latter. The standard Cooper Hewitt lamp is not ordinarily run at a higher density than a pressure equal to about 1/8-inch mercury column, while the pressure in an operating quartz lamp may be that of the atmosphere or higher with the result that the temperature in the luminous vapor is extremely high. With the high vapor pressure potential fall per inch of the luminous column is very great, thus necessitating the use of a correspondingly short tube.

The ordinary Cooper Hewitt lamp and the Quartz Cooper Hewitt lamp in spite of having been built upon the same physical foundations, represent from the practical point of view, two contrasting types; the one possessing great area of luminous surfaces with a consequent small intrinsic brilliancy and a low temperature; the other with a small radiant surface giving a very concentrated and intense light and working at very high internal temperatures. Besides the discontinuous spectrum characteristic of mercury the Quartz lamp, owing to the high temperature, omits, like other incandescent bodies, a luminous spectrum, and it is due to this circumstance that the light of the Quartz lamp contains, besides the predominant yellow, green, blue and

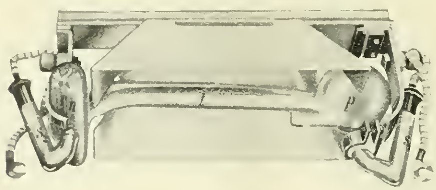


Fig 1

violet lines of the mercury spectrum, red and orange rays, there being more of the latter the higher the vapor temperature.

A vacuum container for the direct current Cooper Hewitt Quartz lamp is shown in Fig. 1. Its main part is the tube "t" carrying the luminous vapor terminating on one (the positive) end of an enlargement "p" and on the other (negative) end in the lateral tube "n." Mercury in each enlargement forms the two electrodes, which receive the electric current by small upright U tubes "s_1," "s_2." Rods of slightly conical shape, of a special alloy, are ground into the wall of these upright tubes and the joints are covered with mercury which again is closed in by a layer of a suitable compound to prevent access of air and prevent the mercury from being spilled or vaporized.

The essential parts of a commercial Quartz lamp outfit are the following:—A series resistance for regulating the burner voltage and making the lamp adaptable to a wider range of supply voltage; a series induction for steadying the arc; a glass globe to prevent too rapid a dissipation of heat from the burner, and to absorb the ultraviolet rays; and, if the lamp is to be automatic, a starting device.

When a cold Quartz lamp is started it requires, owing to the small drop of potential at the low pressure, a rather high current and the whole cross-section of the luminous tube of the burner is filled with a pale bluish-green light. But presently, as the lamp warms up, the appearance changes; the light recedes from the walls, and, with increasing vapor pressure, becomes concentrated in the center of the tube in a thin dazzling path. The current, at first

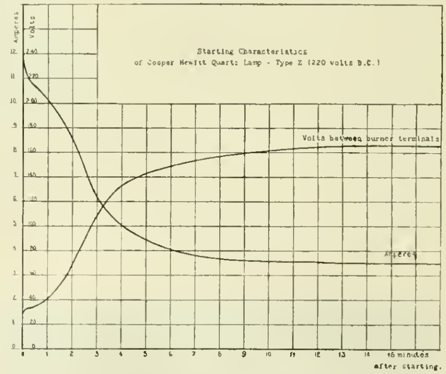


Fig. 2

steadily dropping, becomes stationary, and the appearance of the light assumes a whiter color with a visible gain of red and orange rays as the lamp attains its temperature of operation. The change of the lamp current, and the voltage of a 220 volt—3.5 amp. Cooper Hewitt Quartz burner with reference to the time after starting is shown in Fig. 2.

The ultraviolet rays in which the mercury is especially rich, and which are readily transmitted by quartz, may be considered injurious to the eyes for a short distance. The most actinic of these rays, that is, those with the shortest wave length, are absorbed by passage through a few inches of air; further, all are completely absorbed by common glass, so that a surrounding globe of clear glass affords absolute protection from these rays. The bacterial and physiological effects of the ultraviolet rays are too well known to be dwelt upon here but they have no effect when the light has passed through a glass globe. When a Quartz lamp is used for the purpose of the generation and utilization of ultraviolet rays, no glass should be inserted in the path and the lamp should be placed as close as possible to the exposed object.

Two types of Cooper Hewitt Quartz lamps are here described. These are for multiple connection on d.c. lines, one for 110 and the other for 220 volts. From a.c. supply

circuits they may be operated through the medium of the Cooper Hewitt rectifier.

The 110 volt-4 amp. Quartz lamp is shown in design, in Fig. 3. This figure shows a burner, b, similar to that in Fig. 1. The burner is securely held in an aluminium support, s, to which a white enameled reflector, r, is fastened. The holder with its T-shaped backbone is pivoted in a support, c, and by means of the tilting lever, l, is linked to the movable armature of an electro-magnet, m. In order to avoid sudden shocks to the movable parts, a dash pot, d, is connected to the armature. A small movable permanent magnet, p, is suspended above the armature; it locks automatically the tilting device when the polarity at the lamp terminals is reversed and so protects the burner against being destroyed by a reversal of polarity. Two small resistance coils, r_1, r_2, one equipped with a fuse wire, f, and a sliding contact for regulation, complete the auxiliary apparatus. The ventilated canopy, the insulated hanger and the ring holding the glass globe are very similar to those used with arc lamps.

Burner, magnet and resistance are all connected in series and the burner in its position of rest is inclined, so that the two mercury electrodes are in contact. When the line switch

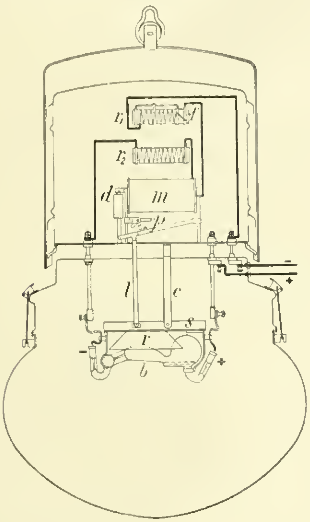


Fig 3

is turned on the short circuit current magnetizes the solenoid m, the movable armature, and with it the burners are turned on their pivots until the contact between the two mercury electrodes breaks and the arc starts. As long as the lamp is under current the burner is held in its running position by the magnet. The fuse wire, f, will withstand the heavy current during the starting period of the lamp, but will, within one minute, be fused by the additional heat generated in the resistance spool, r_1, if for any reason the mechanism should stick and the short circuited burner continue to receive current.

The 220 volt-3.5 amp. Quartz lamp shown in diagram in Fig. 4, has a burner and a general appearance very similar to the above described, but its mechanism is different. The running position of the Quartz burner, is identical with its position of rest. For starting, the two electrodes are brought in contact by the movable armature of a shunt magnet, M_s. At the moment of the short circuit between the electrodes the series induction coil m, operating an automatic cut-out, f, is energized and interrupts the circuit of the shunt magnet, so that the burner drops back to its original position and the arc is lighted. This auxiliary is also provided with an automatic locking device for protection against reverse of polarity. Four series resistance coils r_1, r_2, r_3, r_4, the first two

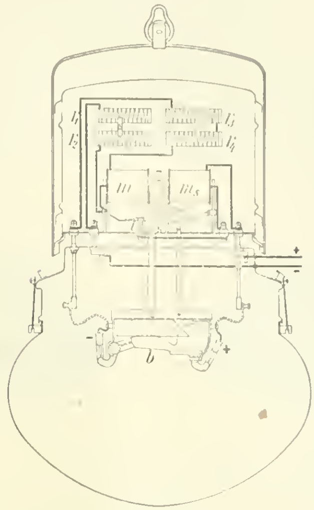


Fig. 4

of which are equipped with the sliding contact, complete the mechanism.

New Things in Holophane

For large interior lighting, such as the lighting of churches, public halls, stores and rooms of unusual dimensions, the larger sizes of the tungsten filament lamps are found to best meet the requirements of the high standard of illumination now demanded. They at least have the preference over other high intensity lighting units at the present time. The extreme brilliancy of these units, particularly

Fig. 1

in sizes ranging from 150 to 500 watts, has in many cases occasioned less thought and study as to results in illumination than was formerly given to the same wattage divided into smaller units. Globes and reflectors are often used that

have too much absorption or, by lack of proper calculation, do not influence the light, so that results on the plane to be illuminated fall far below the maximum that could be obtained. A great glare of light often misleads the layman into thinking he has an ideal lighting scheme, when with the proper treatment of the unit he could obtain double the value, or the sâme illuminating value much more economically.

To meet the demand for obtaining maximum results in the use of these lamps the Holophane Company, Limited, Toronto, have recently brought out several new units that are remarkable in affording illumination results as well as opportunities for ornate fixture treatment.

The Realite, it is claimed, is unequalled for results in illumination by any total enclosing unit. It consists of a

Fig. 2

Fig. 3

most powerful concentrating reflector, Fig. 1, used in conjunction with a shallow satin finished diffusing bowl the two joined by a metal band. The results are wonderful and the fixtures can be made plain or may be elaborated upon to suit the users' fancy.

The new two piece Reflector Bowl units, Figs. 2 and 3, are similar to the Realite but utilize different bowls and afford some extremely pleasing effects. These also give the fixture dealer much latitude in working out rich effects and, like the Realite, come in sizes for the 150-250-400 and 500 watt tungsten lamps. There is an immense field for these units and dealers and central stations who are building up their own interests by promoting greater satisfaction among their customers, will find these will greatly supplement their efforts in this direction.

Canada's Northern Water Powers

Very little is yet known of the value of the natural resources of Canada's far northwest, though explorers have, from time to time, described, in general terms, the great rivers, such as the Mackenzie, the Athabaska, the Slave and the Peace. During the past two summers, the Commission of Conservation has had a hydro-electric engineer at work gauging streams and examining possible water-power sites in this region. Two of the rapids examined were the Fort Smith rapids and the Peace River canyon.

The Cassette, Mountain, Pelican and Drowned rapids, collectively known as the Fort Smith rapids, are situated on the Slave river and extend from Smith Landing to Fort Smith, a distance of some 16 miles. The various rapids, whose descents, taken separately, vary from 10 feet to 38 feet, may be considered as a continuous rapid from head to foot, broken by short intervals of swift water, giving a total descent, in the 16 miles, of some 135 feet. It would probably be difficult to group all these rapids into one development, although it would be very desirable to do so from the standpoint of conservation, but numerous islands and projecting points from the mainland afford natural conditions for easy development. The volume of water in these rapids is enormous, being the combined flow of the Peace and Athabaska, and their tributaries, with one of the great northern lakes, Lake Athabaska, acting as a reservoir to regulate the flow. The total power available during the season of navigation (May to November), by utilizing the total head of 135 feet, is estimated at 1,000,000 h.p., and is divided among the different rapids in proportion to the head in each. Raw material for pulp and lumber industries is found all along the river and at the rapids.

The Peace River canyon has long been renowned for the wild character of its waters, and no white man or Indian ever attempts to run its rapids. The descent from head to foot is some 225 feet in a distance of less than 18 miles, which suggests its possibilities as a water-power. The total minimum power available during the open-water season (May to November) is estimated at 400,000 h.p. This is based on the assumption that the total head of 225 feet can be utilized. Its development for water-power purposes will involve rather intricate problems, but to compensate for this, one must consider its situation near the raw material for pulp and lumber industries. It is also at the head of navigation of the Peace river and lying adjacent to it are immense coal fields, a large portion of which have already been staked out.

Personal

Mr. G. W. Jones, Port Hope, is president of the Canadian Independent Telephone Association.

Mr. Thos. Coleman, until recently with Chapman & Walker, Toronto, has been appointed superintendent of the Charlottetown, P.E.I., Light & Power Company.

Mr. E. A. Graham, formerly assistant to Mr. C. R. Ross, resigned, has been appointed to the position of Electrical Engineer for the Winnipeg Electric Railway Company.

Mr. F. Jno. Bell, general manager Canada Wire & Cable Company, left Toronto a few days ago for a trip to Vancouver and other western cities.

Mr. R. H. Long, formerly assistant superintendent of the Winnipeg Electric Railway Company's hydro-electric plant at Lac du Bonnet, has been appointed to the position of electrical superintendent of the company.

Mr. C. R. Ross has resigned his position as Electrical Superintendent and Engineer for the Winnipeg Electric Railway Company. Mr. Ross has been with the company in this capacity for the past six years, and now leaves to engage in private business.

Mr. C. H. Cahan, K.C., president of the Western Canada Power Company, is now in England, with reference to the proposed contract to sell power to the British Columbia Electric Railway Company. Both companies have made proposals, neither of which apparently have been acceptable to both.

Mr. C. M. Tait has been appointed to succeed Mr. James Bennett as chief electrical inspector of the Canadian Fire Underwriters' Association, Montreal. He has been for two years chief assistant to Mr. Bennett, who retires at the end of March. Mr. Tait has had a long experience in electrical work, having been connected with the Westinghouse and General Electric companies and the Block Signalling department of the C. P. R. Prior to joining the Fire Underwriters' staff, he did a large amount of inspection work under the late Mr. F. H. Badger and Mr. W. J. Plews, during the period when inspection was not on such a well organized basis as it now is.

Mather, Yuill & Company have just completed their contract for the installation of 66 ornamental cluster lighting standards on Robson street, between Granville and Jervis streets, Vancouver. These standards are of similar design to those already installed in the principal streets of the city.

The Dealer and Contractor

Electric Vehicles

The subject of the influence of electric vehicles on central stations, and on the other hand of central stations on electric vehicles, has been discussed more or less widely. From the central station point of view the electric vehicle seems to present tremendous possibilities in the way of increasing its load factor in that current required for charging the batteries is used or can be used in ninety-nine cases out of one hundred at hours when the energy is not being used for other purposes. It follows that in hydro-electric plants at least, this is clear gain to the central station and is almost so in any case where the machinery has to be kept running.

The other point of view—the influence of the central station on the electric vehicle—has not received the same attention, but was recently given prominent notice in a paper read by Mr. Stephen G. Thompson at a recent meeting of the Electric Vehicle Association of America. Mr. Thompson's paper and two charts, showing the influence of an organized attempt by his company to work up the electric vehicle business, are given herewith.

Probably no better example of the influence of the central station on the electric vehicle industry exists than in those sections of New Jersey served by the Public Service lines. Two years ago this territory presented a virgin field for electric vehicle exploitation. The manufacturers themselves were but casually attempting to market their product, and the public at large was not sufficiently informed of the merits of electric vehicle operation to take kindly to its adoption. Aside from a few commercial vehicles operated by manufacturing plants and by New York business houses, but few of these machines were in use, and, with the exception of those power wagons owned by the Edison Storage Battery Company and allied interests, there were no large installations in the state. Pleasure vehicles had met with little favor, there being a total of but 80 machines—many of an ancient type and nearly all but infrequently used.

An investigation of the electric vehicle conditions in those cities which were leaders in the use of these machines influenced the Public Service Electric Company to attempt their introduction in its territory, and for that purpose an Automobile Department was established, whose accomplishment in the introduction of vehicles is graphically represented by Chart No. 2, which shows the increase in the number of vehicles since the inception of this department.

Curve "D" represents the number of vehicles within the territory.

Curve "E" shows the total number consuming current from the Public Service lines.

Curve "F" shows the number of pleasure vehicles in use.

Curve "G" shows the number of vehicles of the commercial type.

It will be observed that the increase in the number of pleasure vehicles is practically a straight line rise. This is accounted for by the fact that the attitude of the Public Service Company immediately influenced the manufacturers of these machines to engage actively in marketing their product in this territory. The variations from the straight line curve are attributable to the influence of the seasons.

The commercial vehicle increase is shown to be of a slower growth during the early period of activity, while the rise in the last few months is quite marked. This is a natural condition, as the development of power wagon use necessarily requires a longer introductory period of education than that of the pleasure machine.

An analysis of the power wagon conditions in this ter-

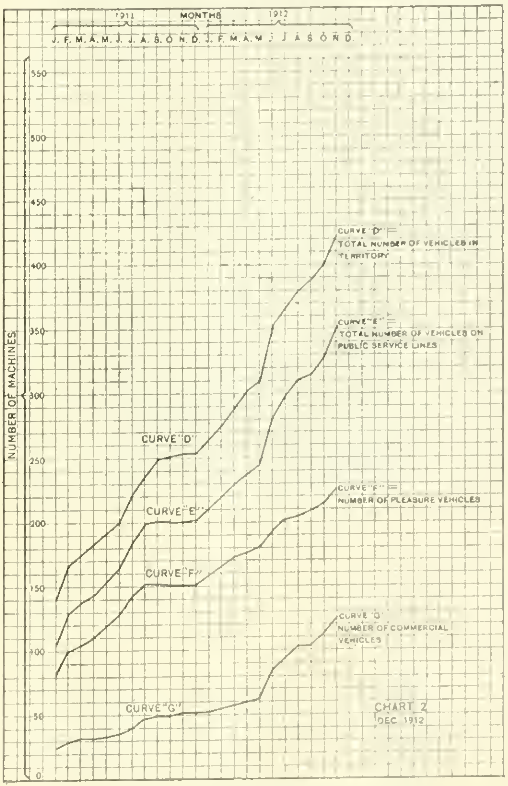


Fig. 1—Chart No. 2

ritory to-day discloses some rather astonishing facts regarding the status of the electric commercial vehicle, and if these conditions may be accepted as an indication of the general

trend throughout the country, we need have no fear for the future of the electric commercial power wagon industry.

At the present time we find a total of 731 commercial vehicles of all types employed within this territory. From the curve it will be observed that 191, or 26 per cent. of these are electrics. The balance are gasoline machines. As this 26 per cent. in electric machines represents the product of but nine vehicle manufacturers, while the 74 per cent. of gasoline machines were marketed by 158 makers, it would appear that the electric vehicle manufacturers are certainly obtaining their full share of the total power wagon business.

If we go further into the analysis of these figures, we

Fig. 2—Chart No. 1

discover that of the 540 gasoline machines in operation, 355 are low-grade cars whose selling price is in the neighborhood of $1,000. In this class are represented 60 vehicle makers, while the balance of 185 gasoline cars are the product of 98 different companies. In other words, over fifty per cent. of the total number of high-grade power wagons employed are of the electric type. Let me impress this statement upon you more strongly. Nine electric vehicle manufacturers, in competition with 98 gasoline makers, have marketed fifty per cent. of the total number of machines of similar quality employed within the territory under discussion. Under the circumstances it would appear that the acceptance of the gasoline power wagon is the influence of numbers rather than of quality or of possible application.

Chart No. 1, showing the increase in kw. consumption and income, will appeal strongly to the central station manager, as the data therein contained indicates just what the use of power wagons means to his department.

Curve "A" represents the average income rate per kw.h.

Curve "B" represents the income in dollars.

Curve "C" represents the kw.h. consumption.

If this plotting is compared with Chart 2 it will be observed that the rapid increase in power consumption follows a marked increase in the use of commercial vehicles, and points to the fact that the introduction of these machines is of far greater importance to the central station than is that of the pleasure vehicle.

The decrease in the average kw.h. rate as shown on Curve "A" is attributable to the fact that a majority of these commercial power wagons are in the larger installations, and public garages, paying for their service at the wholesale power rate.

While these curves are plotted to the first of December, it is interesting that the indications point to a continued rise throughout December because of the vehicles which have been sold, but are not yet delivered, and assurances of additional business from cars not now charged from the Public Service lines, which are at present included in Curve "D," Chart No. 2. Of these are some 40 machines of the commercial type.

It is evident from the foregoing that the influence of the central station on the electric vehicle industry is far-reaching in its results, and from reports of the vehicle manufacturers themselves, I have every reason to believe that educational campaigns in other sections have produced a marked increase in the number of electric commercial vehicles employed. I am strongly of the opinion that if central station managers would make a market investigation of the local conditions, with a view to promoting the use of electric power wagons, they would find the field to be much larger than is generally believed; and, further, that the business can be secured with a very reasonable expenditure of money. This is borne out by the fact that in the operation of our Automobile Department our income has always exceeded the amount expended in promoting the use of electric machines, and we shall finish the year 1912 with a good profit. From our experience and our faith in the future of the electric vehicle, we feel that the ultimate wholesale introduction of power wagons can best be attained by continued effort along the lines which we have pursued during the past two years, rather than through extensive expenditure of a more or less speculative nature. Possibly we are wrong in our premises, but at any rate it is good business procedure.

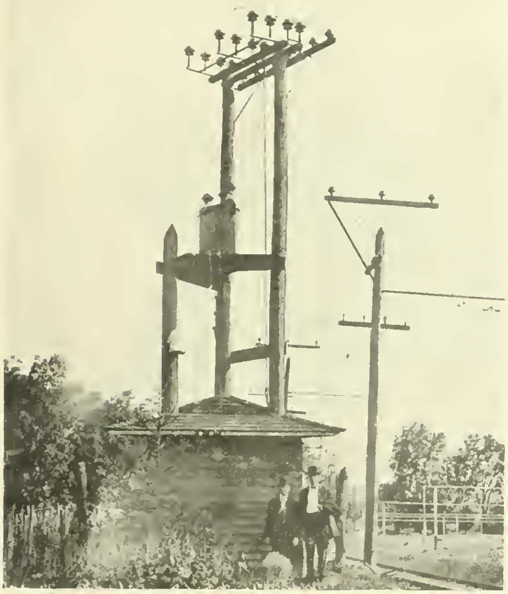
An Ideal Electric Plant on the Farm

One of the most important developments of the next few years in many parts of Canada will be the extension of electric power and light lines for the use of the more progressive farms. There is no doubt about the adaptibility of electrical equipment for this work and the main factors standing in the way of its more general adoption in the past have been (1) the absence of power lines in farming districts; (2) the cost of the equipment; (3) the ignorance of this class of consumer of the possibilities of electric power. The first difficutly has now been removed in a large number of communities not only in Ontario but in various sections at different places in Canada. The cost of apparatus suitable for this class of work is also being slowly reduced without any loss in its efficiency or dependability. Much has also been done to educate the farmer and he is showing himself an apt pupil in grasping the ideas contained in the demonstrations of the last year or two.

A brief description of an actual installation which has been found to work with remarkable success with therefore

be of interest to all and of value to many. Such a description follows of electric equipment installed on a very valuable 60 acre farm owned by Mr. W. W. Mills of Marietta, Ohio. The farm is situated about 2 miles outside the town. The transmission line carrying 22,000 volts runs past the farm. Mr. Mills has installed a transformer to step this voltage down to ordinary working pressures, that is, either 220 or 110, and has equipped his farm with all the useful apparatus available, thereby reducing labor costs, and increasing the efficiency of the laborer.

The accompanying illustration indicates the simplicity of such an installation. It consists of a 3-phase, 60 cycle, 15 kv.a. standard outdoor type transformer giving either 110 or 220 volts. The small building shown contains a switchboard, a watt-hour meter for measuring the energy used, and an auto-starter for a 10 h.p. motor located about 1,200 feet away on a river bank and which is used for pumping water into a tank located just behind Mr. Mill's house. On



Electricity on the Farm

occasion this water system is also used for irrigating the farm, an operation controlled by means of several valves which can be opened or closed, and the water allowed to flow by gravity through piping. This pipe is perforated at intervals thus spraying the water over the land.

Appreciating the many advantages of electrical devices in the home, further advantage has been taken of this electrical installation to light the residence and farm buildings and equip them with the many modern electric devices that do so much to make home-life comfortable. Accordingly there have been installed in the residence, an electric toaster, stoves, irons, vacuum cleaner, a motor-operated sewing machine, etc.; also the washing is done by an electric washing machine. The out-buildings are equally well equipped to enable the farm hands to carry on with efficiency and despatch the drudging work that under present conditions every farmer has learned, more or less, to dread.

This installation has proven conclusively to the company owning the power line that it is entirely feasible to tap for power and light purposes a 22,000 volt transmission line which had hitherto been used only for supplying energy to an electric interurban railway. It is now the intention to supply a number of villages and farms along the line in this way and thus derive a considerable revenue at a comparatively small outlay of money. It is calculated by this company that if they are able to make from ten to fifteen taps ranging from 15 to 100 kv.a. capacity on a transmission line of from fifteen to twenty miles in length, they would derive sufficient revenue to pay entire maintenance charges of the line.

This view of the situation is becoming more thoroughly appreciated by central station managers throughout Canada and the prospects are that the year 1913 will see a very considerable amount of business secured from farmers along interurban lines. Around Toronto four companies are already making a revenue from this source, or are prepared to do so. The Hydro-electric Power Commission of Ontario are supplying a limited number of farmers. The Electric Power Company operating in the Trent Valley are also following this course, the intention being to develop that kind of business. The same can be said of the Toronto and York Radial Railway Company, Toronto Electric Light Company and allied interests.

The installation of the electrical equipment in this case was made by the Westinghouse Electric and Manufacturing Company. The fact that out-door switching and transformer equipment can now be obtained standard, obviates the necessity for a large enclosing station, and so reduces the cost materially.

Pole Top Disconnecting Switches

The pole top switches are an essential feature of every well designed transmission system and are coming into more general use as the sole switching equipment of the high voltage side of outdoor sub-stations. Such switches should be made so as to open all poles at once from the ground, in

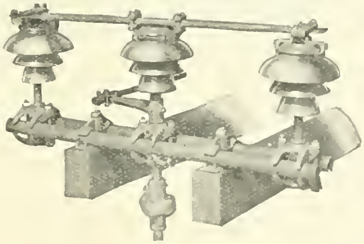


Fig. 1

order to ensure the safety of the operator. They can be obtained in single, double, triple or four pole types of either the single or double break feature per pole, as well as in a combination of these features for use in connection with fuses.

Fig. 2

A single pole of a 30,000 volt, 150 amp., pole top switch of the double break type is shown in Fig. 1. The contacts are

of the flexible, self-aligning type. The switch is furnished so that it can be locked in either the open or closed position as desired. This style of switch when equipped with discharging horns has been found capable of breaking considerable loads.

A triple pole 22,000 volt, 100 ampere pole top switch of the single break type is shown in Fig. 2. This style of switch can readily be mounted either vertically or horizontally, the control handle adapting itself to either mounting, as well as at either the center or the end of the switch as desired. The switch as illustrated in Fig. 2 is not equipped with fuse tubes or fittings, but can be so furnished if required.

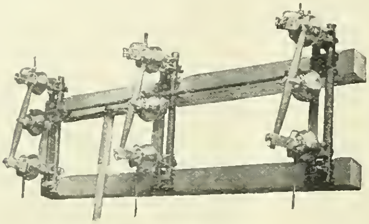


Fig. 3

In Fig. 3 is shown a triple pole 15,000 volt, 100 ampere combined switch and fuse, the usual switch blade in this type being supplemented by a hickory tube boiled in linseed oil, dried and then varnished. The hickory tube contains the fuse, which is readily renewable. The switch and control handle can be mounted in a similar manner to that described above.

All three types of pole top switches have been so designed that the work required for installing them is of the simplest and most elementary nature, consisting of bolting the switch units, which are shipped completely assembled, to the arms and attaching the control. The switches are built with clamped pipe arms, and are capable of adjustment in every way, thus affording a rigid construction readily adaptable to standard pole line framing. It is only necessary for the user to furnish the required pole and cross-arm work. Of the many uses to which switches of the type described above have been put, the most usual are:—Opening branch lines, disconnecting transformer banks, diverting energy past sub-stations when installed upon the roof, disconnecting portable sub-stations from high-tension lines of electric railways, and as line sectionalizing switches. The switches illustrated above are manufactured by the Electrical Engineers Equipment Company, Chicago.

Large Pumps for Ottawa

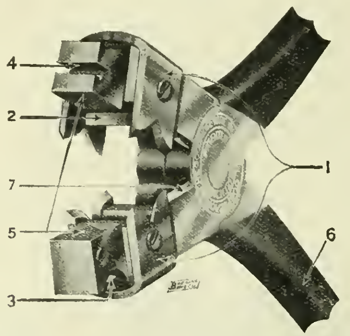
In addition to the two Rees Roturbo centrifugal pumps, electrically driven, for the city of Ottawa waterworks system (mentioned in our January 1 issue), Heap & Partners, Ltd., Montreal, have supplied to the same city three sets of similar pumps, of a capacity of 15 million gallons each. The motors are by the Canadian General Electric Company, and are 50 h.p. 900 r.p.m. 3 phase 60 cycle 550 v. squirrel cage type. These pumps were delivered at Ottawa in five weeks after the receipt of the order. Heap & Partners have delivered two Rees Roturbo pumps for the Brampton, Ont., waterworks, the motors being by the Lancashire Dynamo and Motor Company of Canada, Limited. The pumps are arranged so that they can be operated either in series or parallel. Another order for pumps is for the Dunnville, Ont., Waterworks Commissioners, these being also arranged in the same way.

An 'Ideal' Move.

The Ideal Electric and Manufacturing Company of London, Ont., have moved from their old locations on Bathurst street to larger premises on Talbot street, London, where their new factory is fully equipped to take care of their growing trade in iron, toasters, radiators, stoves and other electric heating devices. The "Ideal" line is well known to the trade and is growing in popularity year by year. A change in the personnel of the firm has recently been made through the dropping out of Mr. T. Agar, whose place has been taken by Mr. R. J. Gracey who will carry on the business in partnership with Mr. W. A. Cooper.

New Wire Pliers

The accompanying cut illustrates the Goodridge Wire Skinner, a tool that will go far towards revolutionizing the method of making connections on insulated wire. The peeling of an insulation with a jack-knife is at best slow and tedious, to say nothing of the quality of the work, whereas one clip of the jaws of the Goodridge wire skinning plier accomplishes the same thing quickly and neatly. The above figure indicates the various parts of the tool as follows: 1 represents the knives for cutting the insulation; 2 is the knife for stripping the insulation; 3, a knife for scraping the wire; 4, a slot for bending loops in the end of the wire; 5, jaws for pulling off the insulation; 6, handles; 7, side cutting jaws.



As it is calculated that No. 14 wire is used in much greater quantities than any other size, this tool is only made for that wire number at the present time. This plier is manufactured by Mathias Klein & Sons, Chicago, Ill.

1913 Diary

F. Reddaway & Company, manufacturers of the well-known "Camel" and "Camel Hair" brands of belting and linen fire hose, stitched cotton belting, etc., 595 St. Paul street, Montreal, Que., have sent out to their friends a useful little pocket diary neatly bound in red leather. The diary contains pages for memoranda of various kinds as well as a useful assortment of general information upon subjects which everyone wishes to have at his finger ends. The company advise us that although the supply is limited they will reserve a few copies of this useful little pocket book for readers of the Electrical News who may inquire for it.

Sterling Telephones

The sole Manitoba agency for the Sterling Telephone and Electric Company of London, Eng., is now held by the Canadian British Engineering Company, Limited, 324 Smith street, Winnipeg. The Jas. Stuart Electric Company were formerly the agents. It is announced that the Canadian British Engineering Company will carry a large stock of apparatus and be able at all times to make prompt delivery.

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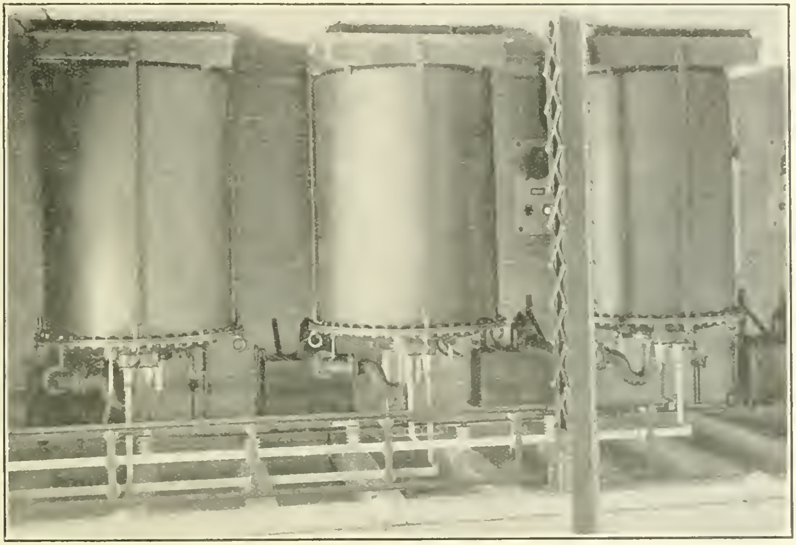

3 of 7 Siemens 22,000 volt single phase oil insulated water cooled transformers supplied and installed for the city of Port Arthur

Four of the above were a repeat order after the first bank had been in successful operation for eighteen months.

We also supplied the whole of the switching apparatus, lightning arresters and two 750 h.p. motor generator sets.

Attention is especially drawn to the expansion vessels connected by a pipe to the top of the transformer case. Our transformers are completely filled with oil including this connecting pipe, and part of the expansion vessel, expansion and contraction of the oil taking place in the latter.

By means of the peculiar shape of the connecting pipe the hot oil by the time it rises to the expansion vessel is sufficiently cool so that **no hot oil comes in contact with the air, and no moisture can enter the transformer itself.** This arrangement also keeps the oil in perfect condition and prolongs the life of the transformer.

Siemens Company of Canada, Limited

HEAD OFFICE:

Transportation Building - MONTREAL

BRANCH OFFICES:

STANDARD BANK BUILDING
TORONTO

McARTHUR BUILDING
WINNIPEG

Independent Electric

The Independent Electric Manufacturing Company announce the completion of their new factory in the city of Milwaukee.

This new and larger building, made necessary by the growing demand for their products, is thoroughly modern in every respect and is equipped with ever facility for an increased production of electrical controlling devices of the highest quality. The new Experimental Department is additional facilities for the development of new devices to supplement their already very complete line.

Thordarson's Improved Sign Lighting Transformer.

Reports of advances made in the commercializing of electricity are always received with great interest, and this is true of the recent announcement of an improved sign-lighting transformer by the Thordarson Electric Manufacturing Company of 503 S. Jefferson street, Chicago. Like all their electrical apparatus, the Thordarson improved sign-lighting transformer was designed and made with a complete and experienced knowledge of exact service conditions and the materials and workmanship are the best obtainable. The radical improvements incorporated in these transformers

by the Thordarson experts are said to be strongly endorsed by the National Board of Fire Underwriters. The new model is very compact and neat in appearance and is claimed to be the smallest transformer on the market, also weighing less than any other type. At the same time highest efficiency is attained and it is guaranteed to withstand a breakdown test of 2,500 volts between the primary, secondary and core. Some of the largest sign manufacturers have already given the new transformer an exacting trial and report every claim fully sustained in use. The illustration covers the improved type. Eight stock sizes 100 to 2,000 Watts inclusive.

Bruce Peebles & Company Personals

Mr. Lee Murray has been appointed to the seat on the board of directors recently vacated by Mr. Chas. H. McEnen.

Mr. S. E. Bastow and Mr. J. H. Bunting have been appointed joint managers in the place of Mr. Murray, who has retired from the position of general manager of the company.

The Engineering Equipment & Supply Company, electrical apparatus, 410 St. James street, Montreal, announce that they have opened a branch office in the Stair Building, Toronto (phone A. 3096), in charge of Mr. A. G. Manley as manager.

Trade Publications

Pneumatic Tools—Bulletin No. 34F issued by the Chicago Pneumatic Tool Company, being a mechanical description of the design and construction of class G. Chicago pneumatic compressors.

Eye Comfort System—A bulletin has just been issued by the National X-Ray Reflector Company of Chicago, dealing with the use of indirect illumination in churches. The subject is treated in an interesting way and is splendidly illustrated.

Synchronous Motors.—Pamphlet issued by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., describing and illustrating Westinghouse synchronous motors, type G, 60 cycle, two and three phase, voltages 240 to 2,400, h.p. 30 to 250.

Economy Fuses—Booklet issued by the Economy Fuse and Manufacturing Company, descriptive of their renewable cartridge fuses. It is claimed that in mechanical strength, positive electrical contacts, permanence and electrical performance, the Economy renewable cartridge fuse is superior to all other designs of cartridge fuse that have been developed.

Motor Converters.—Pamphlet No. 208, issued by Bruce, Peebles & Company, of Edinburgh, descriptive of Peebles motor converters. This pamphlet is being distributed by Roper, Clarke & Company, Room 422 Coristine Building, Montreal, Canadian agents for the Edinburg company. This pamphlet describes briefly the difference between former and present sub-station practice and explains fully the principle of the motor-converter and its general design and construction. Motor-conveters for various types of work are explained.

Electrical News

Generation, Transmission and Application of Electricity

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Lightning Arresters

Apparently the most important advance that has been made in recent years in the theory of high tension transmission and the difficulties surrounding it, is contained in the announcement that much of the trouble which was formerly supposed to be due to excessively high voltage is now believed to be caused by high frequencies. That is, it is now believed that whereas a high tension line may operate normally at 25 or 50 or 60 cycles, a lightning flash in the vicinity of the line may increase this number enormously to anywhere in the neighborhood of 1,000,000 cycles. Thus it would appear that the apparatus that has been designed in the past to withstand voltages of two or three times the normal working voltage of the line has not fully provided for one of the most important contingencies.

This point was brought out recently in a paper by Messrs. Imlay & Thomas, describing some experiments they had made in connection with the design of insulators for a new line. In these investigations it came out that insulators constructed and tested for a normal working voltage of 20,000 to 30,000 votls would puncture repeatedly at a much lower voltage than this when the frequency of the discharge was increased to a number comparable with that of a lightning flash. As a result of these experiments therefore, an insulator was finally designed, having in view the destructive effects of high frequency discharges rather than those of high voltage.

The present issue of the Electrical News contains an article on lightning troubles by Mr. Lofvengren in which the author speaks of the weaknesses of the average lightning arrester and maintains that a type of equipment similar in operation to an ordinary condenser is the only satisfactory means of taking care of this high frequency discharge. It is pointed out in this paper that lightning troubles are due to three causes, (a) Static charges of electricity which may set up a surge on the line and which are best cared for by some short circuiting low resistance type of equipment. (b) Lightning flashes which strike the line and which, it is claimed cause only local trouble and (c) high frequency surges which are the result of lightning flashes taking place from cloud to cloud or from cloud to earth in a direction approximately parallel to the line. These induction high frequency surges, it is claimed, are the ones which travel considerable distances along the line, and are responsible for most of the destruction to generators, transformers, etc. For this kind of trouble the condenser type of lightning arrester is claimed to be particularly effective. The article deals with the question in a more or less mathematical way but the underlying principles may be understood without any reference to these parts.

Auburn Power Plant

In this issue we print a detailed description of the development plant of the Electric Power Company at Auburn dam in Peterborough, in which a number of unique features have been introduced. One of these is the installation of a specially designed and practically water-tight travelling sluice gate which has been provided for emptying the wheel pit for repair or examination purposes. This gate is some 15 ft. x 14 ft., constructed of riveted boiler plate, and carried by a travelling gantry constructed of structural steel and mounted on four cast iron wheels. The gate itself is fitted with circulating rollers at each side to run in the concrete stop log gains. With this arrangement the gate can be lifted or lowered under a full head of water with the turbine gates wide open. Leakage is reduced to a minimum by means of adjustable skin side-bars which serve as guides and are set into place after the gate is closed. The gate is moved along the rails by means of a hand-gear, but can be raised or lowered electrically. Even against quick running water passing through the opening, under the maximum head this gate can be lowered or raised in about $2\frac{1}{4}$ minutes.

Another interesting departure in the design is that in connection with the transformer house. No crane has been provided here, but a door is placed in front of each transformer which admits of the unit being run out of the transformer house (on a track) after which it is run down to the power house for disassembling. This greatly reduces the size of the transformer house and saves the expense of extra equipment. Another feature is the provision made for a railway crossing over the main river dam which it is intended the Peterborough Radial Railway will use at some future date. In the power house perhaps the most noticeable variation from every day practice is the heavy fly-wheel attached to the generator and particularly the thin disc shape of this wheel by which the manufacturers were able to greatly increase the inertia of their generator without practically any change in design other than a slight widening of the base frame work.

Self-Starting Motors

The electric motor has proved so satisfactory for driving mine pumps and fans that it seems almost impossible to improve it. It can be placed wherever a pump or a fan can be located, a couple of wires supply it with the power it needs, and when running it requires no attention whatever beyond occasional inspection and oiling. In fact, these motors have proved themselves so useful and economical that they are rapidly displacing all other forms of power for fan and pump service wherever electricity is available.

An improvement has, however been recently developed

which greatly increases the value of motors for mine work. This improvement consists in making the direct current motor self-starting. Heretofore, while it has been possible under some conditions to start them from the power house, most motors driving mine pumps and fans had to be started by hand. Hence, if the power went off temporarily for any reason, the motors stopped, necessitating an attendant going to each station to start them again. With the new self-starting d.c. motors, this inconvenience is done away with. When the power fails, the motors stop, it is true, but as soon as the power comes on again, the motors start automatically and settle down to work as though nothing had happened. Moreover, starting boxes are rendered unnecessary, and the wiring is of the simplest possible character. An occasional visit of inspection is now all the motors require. Otherwise they can be left entirely to themselves.

These motors have been thoroughly tried out in practical service and their uses are commending them highly. The electrical characteristics of the self-starting motor differ but little from those of the usual type, the only alteration being in the use of a heavier compounding winding which reduces the flow of current when starting. Mechanically, there is no change. Self-starting motors are made in ratings up to 20 horse power for the voltages usually employed in mine work. They can be supplied for all kinds of pump and fan service.

Red vs. White Cedar

At a recent convention of the Western Red Cedar Association held in Spokane, a preliminary report was made by the United States Department of Agriculture on the relative strength of the northern white cedar and the western red cedar. The report covered a series of tests on fifteen 7 in. top 25 foot poles of each species. The northern white cedar poles were purchased from the Minnesota district which produces them. The western poles were shipped from one of the yards in the neighborhood of Sandpoint, Idaho. In each case, care was taken to secure poles representing the average grade of material.

The test goes to show that the western red cedar pole exceeds in strength that of the Michigan white cedar type by approximately 100 per cent., and is as follows:—

"Since all tests on full sized poles of Michigan white cedar and Idaho red cedar furnished by your association have been completed, I wish to give you a preliminary report of the results of these tests.

"In all, fifteen poles of each species were tested in an Olsen 200,000 pound Universal Testing Machine which had been modified with special framing to accommodate the full sized poles. The two ends of each pole were held stationary and the load was applied at a point corresponding to the gronnd line after the pole is set.

"The Michigan white cedar poles were much inferior in quality to the Idaho red cedar poles, since all of the Michigan poles contained varying amounts of center rot and were very rugged due to a large number of knots, some of them of considerable size. Only three of the Idaho cedar poles showed traces of center rot and all Idaho poles were quite free from knots. The center rot and knots in poles are serious defects when the strength is considered.

"The following figures show a comparison between the strength of the two species of poles which your association contributed:—

	Modulus of rupture, lbs. per sq. in.	Breaking load, lbs. per sq. in.
Michigan white cedar	3,400	8,430
Idaho red cedar	6,670	18,510

"The breaking load given above is not the actual average load required to work the poles to destruction, but is the actual load modified so as to compare the poles on a basis of equal diameters. The modulus of rupture is the unit load in pounds per square inch which disregards size and length."

Farewell to Mr. Kelly

Hamilton, the Birmingham of Canada, the city with 400 industries and which claims the proud distinction of utilizing more electric energy for motive power purposes in proportion to its size than any other city in Canada, was the scene of an enthusiastic meeting of the employees of the Hamilton Electric & Power Company, held under the auspices of the Hamilton section of the N.E.L.A. on Wednesday, January 22nd, over 100 employees being present. Much added interest surrounded this meeting as it was understood to represent the farewell of President T. F. Kelly, one of the best known men to-day in the electric light field in the United States and Canada.

The program included a farewell address by president Kelly; several musical selections; an illustrated lecture on the Panama Canal by G. W. Magalhaes, T.E.L. Co., Toronto; presentation of life-size photograph of President Kelly to the section; response by president-elect L. W. Pratt; and the presentation of a cabinet of silver to Mr. Kelly by the employees of the company. During the evening short addresses were also given by treasurer G. D. Fearman, Mr. W. G. Angus, general superintendent light and power; line superintendent Chas. G. Choate, and by Mr. Geo. W. Ames, ex-president of the Buffalo section. The meeting assumed largely the nature of a farewell to its president, Mr. Thos. F. Kelly, who has been contract agent for the company for the past four years, during which time he has filled the position with credit to himself and to the satisfaction and benefit of the company. Mr. Kelly is regarded as a specialist in sales of the commercial end of the electric light and power business, and has been employed with the H. E. L. & P. Co. in various capacities, continuously, since the year 1900. He is leaving very shortly to assume the position of sales manager at the Dayton Electric Power & Light Co. and its subsidiaries, where he will have a much larger field for the expansion of his activities. To the efforts of Mr. Kelly, almost entirely, is due the formation of the Hamilton section of the N.E.L.A., and since its inception he has held the office of president. He is also a member of the Commercial Committee of the Canadian Electrical Association.

Mr. T F Kelly

Aside from his work in the electrical field, Mr. Kelly has taken an active interest in the development of Hamilton. He was secretary of the Hamilton Ad Club, was an aggressive member of the Board of Trade, and was also on the Publicity Committee of the Hamilton Centennial Association. His affable manner and personality, together with his sterling qualities, have made him a host of friends in Hamilton, who will regret very much that he is leaving them, but will load him with good wishes for continued advancement in his new sphere of action.

The New York state government is at present fighting to wrest from the federal government the control of the water powers on the Niagara river.

Re Underwriters' Requirements

The Editor of the Electrical News,
Toronto, Ontario.

Dear Sir,—I note with great interest your editorial and the accompanying re-print of report made to the British Board of Trade on the above matter. While you are in the main correct as to the high standard of British manufactured articles, there are still a number of appliances and articles of manufacture of British make that are not in many respects up to the standard of American or Canadian goods intended for similar purposes. I know of what I speak as I have been in this work for the last eighteen years and have repeatedly had to refuse to accept British made appliances and material, although this city does not, in spite of the statement of Mr. Wickes, insist upon the Laboratories label. It seems to me in this question that two points have to be considered, namely; first, the standard of quality and the fitness for the duty and, second, the standardization of dimensions of certain appliances, such for instance as cutouts or fuses. You will remember the years of effort that were necessary before a simple matter like the standardization of enclosed fuses was reached and similar action in regard to lamp sockets and lamp bases.

Mr. Wickes seems to be afraid that under the present arrangements the Laboratories impose no restrictions as to the "danger to life" factor. It is true that the Underwriters are largely represented on the National Code Committee, but all the other interests are also represented, and during the last few years the question of "danger to life" has been increasingly emphasized in the Committees' rulings and there are numerous rulings in the code that not only protect against fire, but also enforce the necessary safeguards for the protection of life, as for instance, the grounding of the neutrals of the low tension system. It is rather remarkable that Mr. Wickes should lay stress on this point, as in his own country the requirements have been extremely lax on this point up to a very recent date, in fact, until recently apparatus and appliances have been sold and used in Great Britain that would not be allowed in this country where a properly organized Inspection Department existed; for instance, a long skirted Edison base lamp having a live projection of one and a half inches below socket. Such crude and unsafe methods were eliminated years ago on this side of the water and inspection departments of this country find this form of lamp to-day (constantly imported from European points) to be one of the most serious menaces they have to deal with.

While the British manufacturers are no doubt handicapped by the present conditions, and while as an Englishman myself I am doing everything I can to facilitate the placing of their goods on this market, the whole trouble is due to the fact, to use the words of your editorial, "The Englishman does not feel the need of the same progressive step until he comes into direct contact with the United States product in this continent," and judging by the increasing number of fatalities in the British Isles, due to electrical causes, it will not be long before public opinion will force the authorities to take a progressive step and call for the standardization of electrical fittings generally.

I believe that we should in Canada have a laboratory for testing purposes either under the Government or Underwriters' auspices, whose rulings would be accepted by the American Laboratory, we in turn accepting theirs, so that a uniformity of ruling would exist. I understand that there have already been some proposals along this line, and with the institution of such an examining body the British manufacturers would not be under any disadvantage in exporting goods to Canada. I have at times come in contact with some of the leading members of British firms, who have been over here looking up trade possibilities, and in most cases they have expressed their readiness to adapt their goods to Canadian practice; on the other hand, there are Britishers of the well-known stubborn variety who will think that "what is good enough for John Bull is good enough for Johnny Canuck," but the latter has a habit of suiting himself. I imagine that a form of British standard that would be recognized the world over, will hardly come about.

I cannot refrain from expressing my indebtedness to the American Laboratories for the excellent work they are doing. It is of the very greatest value to the department over which I preside, in fact I do not know how we could get along without the valuable assistance they render from time to time. We are especially pleased with the way they are handling the rubber covered wire situation to-day. Canadian manufacturers have found no difficulty in complying with the Laboratories' tests. Canadian manufacturers are to-day turning out wire with the Laboratories labels and I was only the other day requested to collect samples of wire found in the field and forward same to Chicago, when they would be tested and reported upon free of charge. The value of this service is, as I have said, very great, and I do not think it is sufficiently appreciated.

Trusting that your article will promote a healthy discussion on this important matter, I am

Yours truly,

F. A. Cambridge, City Electrician.

Winnipeg, Man., Feb. 5, 1913.

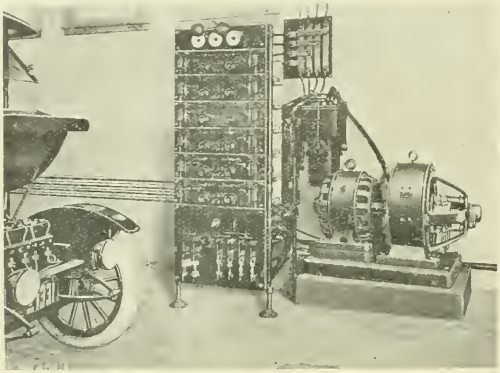
A Pioneer Gone

The announcement of the recent death of Mr. Jno. Patterson, of Hamilton, Ont., carries us back some fifteen years to that epoch-marking day when the Cataract Power Company of Hamilton had just completed its generating station at DeCew Falls and its 35 mile, 22,500 volt transmission line to Hamilton. This line, the longest, and carrying the highest voltage in Canada, at that time, was the conception of Mr. Jno. Patterson. In this connection the following quotation from a description of this plant taken from the Electrical News of December, 1898, will be of interest. "Over three years ago, when the transmission of energy by electricity over long distances for commercial purposes was still in an experimental stage, the possibility of utilizing this magnificent fall of over 200 feet at DeCew Falls, where the waters of the Beaver Dam creek tumble over the Niagara escarpment, for the generation of electrical energy to be transmitted to the city of Hamilton, 35 miles distant, first suggested itself to Mr. Jno. Patterson, of that city. After numerous surveys and examinations into the physical possibilities of the scheme, Mr. Patterson associated with himself the Hon. J. M. Gibson, Jno. Moodie, Sr., Jas. Dickson and J. W. Sutherland, procured a charter and formed the Cataract Power Company of Hamilton, Limited, for the purpose of the development of this power and its transmission to Hamilton." In recent years Mr. Patterson has shown his continued faith in electrical matters in numerous attempts to finance suburban railways in and around his native city. That he was somewhat unsuccessful in realizing his hopes was due to the adverse conditions under which he worked, however, and not in any sense to any lack of faith in the unbounded possibilities of suburban electric traction as a solution of many of the present-day commercial problems.

The House Foreign Affairs Committee of the United States government recently made a report on the bill for a general regulation of the use of the water of Niagara Falls for power purposes. It is understood that no change will be made in the existing law limiting the amount of water to be diverted on the United States side to 15,600 cubic feet per second.

Electric Vehicle Battery Charging

The accompanying illustration shows a new line of battery charging equipments which has been placed on the market by the Westinghouse Electric & Manufacturing Company. A special feature of this outfit is the mounting of all control apparatus on one board. It is usual present practice to have each charging rheostat a separate unit which is located near the vehicle being charged; the charge is regulated by reading the vehicle meters. Considerable difficulty has been experienced in charging by this method because the operator cannot see the vehicle meters when operating the rheostat, and moreover the vehicle meters are apt to be inaccurate on account of vibration and rough usage —in some cases the pointers are broken off. These difficulties are overcome in this new line. The operator makes the proper connections, regulates the rheostat, and reads the charging rate from accurately calibrated meters while standing at the board The outfit is, moreover, very compact and



Battery charging outfit—All control from one point

takes up minimum floor space, as indicated by the illustration which shows a complete installation for charging twelve vehicles at the same time. This switchboard takes up a floor space of 30 ins. by 36 ins.

The switchboard is unique in being made up of horizontal sections. The top section carries the meters which give readings of current and voltage of both the incoming direct current supply and of each battery being charged.

Below the meter sections are the charging sections. Any desired number of such sections can be installed, from one to as many as the limitations of height will permit. The illustration shows six. Additional sections can be supplied at any time. If more sections are required than will conveniently go on one board, they can be mounted on extra panels, which can be brought up to the height of the first one by the use of blank sections if desired. Each charging section furnished a complete equipment for charging two separated batteries The rheostat can be mounted on the back of the panel, as shown in the illustration, or can be separately mounted wherever desired. Rheostat can be furnished for any type of lead and Edison batteries, and for any number of cells. As each rheostat is independent, the switchboard can be made up to charge any desired variety of cars.

In charging a battery from this board, all that is necessary is to insert the charging plug, close the charging circuit, and adjust the rheostat. Each charging circuit is identified by a name plate. The volt meters are connected in the circuits by means of plugs. The individual charging circuit can be controlled by either switches or circuit breakers. If circuit breakers are used, they can be equipped with relays which protect the batteries from overloads and the circuit from reverse current.

The bottom section carries apparatus to control the incoming direct current power, and also, if necessary, the motor-generator set. If the motor-generator set is operated from alternating current, the auto-starter for the motor is mounted on the wall as shown in the illustration. If a field rheostat is used to adjust the generator voltage, it is also mounted on the bottom section.

Motor-generator sets of any capacity and for operation on any commercial circuit can be furnished. It is usual practice to furnish a direct-current generator the voltage of which can be adjusted from 60 to 125 volts by field control. This adjustment permits the voltage of the charging current to be made slightly higher than that required for the batteries being charged, so that there is no great loss of power caused by inserting a large amount of resistance in series with the battery.

In cases where a large motor-generator set, 50 kw. or larger, is required, the addition of another set of approximately 7½ kw. is recommended. The smaller set will efficiently take care of hurry-up calls for charging one or two vehicles when the larger set is shut down, and can be run in parallel with the large set to help out during heavy or peak-load conditions.

Electrical Prosperity in Ottawa

Some concrete evidence of the prosperity of the Ottawa Electric Ry. Co. and also of the growth of the city of Ottawa was given at the annual meeting of the company, held in the head offices on Albert street, on Monday, February 3rd. Nearly 3,000,000 more passengers were carried on the cars during 1912 than in 1911, the gross earnings were nearly $95,000 greater than in the previous year and the increase

Mr. J. D. Fraser

in net amounted to over $45,000. The total dividend for the year paid to the shareholders was 15 per cent., the same as in 1911. The shareholders passed an unanimous vote of thanks to Mr. Thomas Ahearn, the president, and to the board of directors, for conducting the business of the year so successfully. Mr. Ahearn stated that it was expected

the receipts of the company for 1913 would reach the million dollar mark.

One important change was made in the personnel of the board of directors in the election of Mr. James D. Fraser, secretary-treasurer of the company, to succeed Senator Cox, resigned. Mr. Fraser has been connected with street railway work in Ottawa for the past thirty years. He was general manager with the old Ottawa City Passenger Railway Company and when the Ottawa Electric Railway Company took over the system in 1891 was appointed secretary treasurer, a position he has capably filled ever since. The full board of directors are: President, Thomas Ahearn; vice-president, Warren Y. Soper; Thomas Workman, Elbert N Soper, George P. Brophy, T. Frank Ahearn, and James D Fraser (secretary-treasurer).

Municipality Makes Profit

The recent annual report of Mayor Ellis, M.L.A., Secretary of the Municipal Electric Commission, Ottawa, showed a net profit for the year of $35,069.02. During the year the number of customers has been increased from 5,337 to 6,284, and the number of incandescent lamps installed from 93,190 to 109,565. When the city took over the plant in 1905 there were 1,314 customers, 26,160 incandescent lamps, 175 arc lights and 64 motors. The close of 1912 finds the city with 914 arc lights and 231 motors.

The percentage of maintenance and operation, exclusive of power, was 36 1/3 per cent. for the past year. In the seven years and a half the city has been operating the plant less than two per cent. of the total amount of the accounts has been lost. Mayor Ellis announced it to be the intention of the Commission to use the surplus of $35,000 for the extension of the plant, and also in a reduction in the rates.

Adding to Pumping Equipment

Three 50 h.p. induction motors have just been installed by the Ottawa municipal electric department at the pumping station on Lemieux Island. The motors, which were supplied by the Canadian General Electric Company, are now driving three Rees Roturbo pumps of 12,000,000 gallons capacity, which were supplied by the Manisdee Iron Works of Manisdee, Mich., the United States agents for the Rees Roturbo plant, of Wolverhampton, England. The pumps are for the purpose of driving the city's water supply through the pipes instead of drawing it through, as was done formerly. It has been alleged that the drawing of the water through the intake pipe had a good deal to do with causing the recent typhoid epidemic in Ottawa, by sucking contaminated water from Nepean Bay. Since the new pumps began to work the water is taken from the river at the mouth of the intake pipe and lifted into a well 12 feet above the river level and then forced through the intake pipe to the city pumping station

Will Double Capital

Application has been made by the Ottawa Electric Company to the Private Bills Committee of the House of Commons for authority to increase the capital of the company from $1,500,000 to $3,000,000. The Ottawa Gas Company also made application at the same time for authority to increase their capital from $500,000 to $2,000,000. Both applications were granted. Mr. George F. Henderson, K.C., acting for the companies, said that increased capital of the former company is required to keep pace with the demand for installations The need of an additional plant and to provide for the large demands being made for gas was the reason the latter company needed extra money

Activities Around Montreal

Owing to the generosity of Mr J. E. Aldred, president of the Shawinigan Water & Power Company, the town of Shawinigan Falls, P.Q., now possesses a technical school built at a cost of $50,000. The structure is of brick, and is equipped with electrical and other technical apparatus, and here employees of the company and any others who so desire will receive theoretical as well as practical instruction in electrical and other work, both French and English classes being formed. No other place in the province, except Montreal and Quebec, has such an institution, although there has been a technical school in Shawinigan Falls for two years, which was held in rented rooms At the formal opening of the school, Mr. Aldred, in handing over the deeds to the governors, promised that if the time should come when a building four times the size of the one he had given was needed, it would be forthcoming. He had seen the growth of Shawinigan Falls for the past twelve years, when he had organized the power company, and now that prosperity had come as a result of the vast resources of the district he wanted the youth of the place to have such educational advantages as would help them later to further scientifically develop the district, and make it the leading manufacturing district in the province This, said he, would ultimately come, but education was needed.

A special train conveyed a large number of visitors to the town, these including Mr. T. McDougall, vice-president of the company (who presided at the meeting), Mr. Julian C. Smith, chief engineer, Mr. H. Murray, treasurer, and other officials; several prominent educationalists, and members of the Provincial Cabinet. During the afternoon the party visited the power plant.

Outremont will Generate Power

The Town Council of Outremont, P.Q., intend to generate their own power for electric lighting purposes This announcement was made at a conference between the Council and Mr. R. F. Jones, manager, and Mr W. H Winter engineer, of the Bell Telephone Company, in reference to a scheme of the company for laying underground conduits at a cost of $70,000. The Council have also a conduit scheme prepared by Prof. L. A. Herdt, and both plans being on similar lines, it was suggested that the council should co-operate with the company in building one system only with separate trenches for lighting and telephone wires, or alternately, that the council should construct the conduits and charge a rental to the telephone company The latter, however prefer to build their own conduits, and it was agreed that it was imperative for the council and the company to build the conduits simultaneously in order to avoid unnecessary tearing up of the streets The adjustment of this matter and also the question of erecting poles in lanes to carry lighting and telephone wires, was referred to the electric lighting committee.

May Reduce Number of Stops

At a conference between an aldermanic committee, Mr Hutchison, manager of the Montreal Tramways Company, and Mr L. Stern, electrical engineer, the question of the elimination of stops was discussed Mr Alderman [illegible], the leader of the Council, intimated that the city should ask the Legislature at the next session for authority to construct an underground municipal tramway, running north and south and east and west, and when it was built to lease it to the present company for operation Mr. Hutchison argued in favour of fewer stops and the construction of parallel lines and he submitted a memorandum showing the relief that might be expected to result from the elimination of stops

Reported to C.S.C.E.

At the recent annual meeting of the Canadian Society of Civil Engineers, held in Montreal, the Canadian Committee of the International Electrotechnical Commission, of which Prof. L. A. Herdt is chairman, reported that during the year 1912 six publications were issued by the Commission, the most important of which related to Standard Symbols and the rating of electrical machinery. The next meeting of the complete Commission is to be held in Berlin, Germany, in September, 1913, at which time the various propositions now under consideration will be finally adopted. An International Congress, a meeting that will be of the greatest interest and importance, is planned for 1915, in conjunction with the Panama-Pacific Exposition to be held that year in San Francisco, Cal.

Substitute Electric for Steam

In a report to the Montreal Board of Control, Mr. Champagne, boiler inspector, suggests that the city might take steps to secure the abolition of steam locomotives entering the city and the substitution of electric engines. His plan is for all trains destined for local stations on the Island of Montreal to be hauled by electric power or gasoline, this including shunting engines. The expansion of Montreal, he says, is bringing the matter to a point where it will have to be met. The smoke nuisance and the danger from locomotive sparks in the residential districts are reasons advanced in the recommendation as being sufficient for the adoption of electric engines. Controller Godfrey points out that this is entirely a matter for the Railway Commission, and not for the city.

The Perkins Electric Company

The Perkins Electric Company, Limited, have been incorporated with a capital of $50,000, and offices have been taken at 322 Craig street west, Montreal. Mr. George F. Perkins is the president and managing director, Mr. F. J. Parsons, vice-president, and Mr. P. F. Fergusson, secretary-treasurer. The business is that of wholesale dealers in and importers of electrical equipment, and the sole Canadian agency has been secured for Bee Dee fixtures and fixture parts, finished and unfinished, manufactured by the V. Brandt Dent Company of Watertown, Wis. The Perkins Company are also the Canadian agents of the Crown Novelty Company, Chicago, makers of electric portable lamps. Other lines carried include carbon and tungsten lamps, flaming arc lamps, sign lamps, switch plates, and flexible conduits.

May Follow Ontario's Lead

In the annual report of the Council of the Montreal Board of Trade reference is made to the Ontario Hydro-electric Commission, which is undertaking the development of water powers in a very comprehensive manner throughout that province and expects in the course of a few years to offer power at a rate which will be very advantageous both to Eastern and Western Ontario manufacturers. Should this movement, it is stated, prove successful and result in placing Ontario industries in a position of greater advantage to compete with those of Montreal, it would demand consideration by the Board of Trade and other Montreal trade organizations.

A Start at Carillon Falls

The National Hydro-electric Company, which propose to develop a big water power at Carillon Falls, and who are now working on a small plant of 1,000 horse power, in four units, have applied to the Montreal City Council for permission to enter the city and sell power. The application has been referred to the legal department and Mr. Parent, superintendent of the lighting department, to look into the question of the contracts now in force. The company have the right of appeal to the Quebec Public Utility Commissioners in the event of any municipality refusing permission. The financing of the company is now engaging the attention of the directors.

Iroquois Falls

The Abitibi Pulp & Paper Mills, Limited, which is building a big paper mill at Iroquois Falls, on the Abitibi River, Ont., have obtained a lease of the water powers of Iroquois and Couchiching Falls, and have the right to hold and control the waters of Abitibi Lakes for power purposes. Mr. Henry Holgate, of Montreal, has reported on the water powers, and estimates the total power available on the company's property to be 57,195 shaft h.p. Mr. Holgate says that the three water powers are all close together, that the large storage of water in Lake Abitibi is a great advantage, and there need be no fear of shortage of water at any time of the year.

50,000 H.P. at Grand'Mere

The Laurentide Company, Limited, have under way the construction of a large hydro-electric system at Grand'Mere, Que. It is said that at this point 50,000 h.p. can be developed which will bring the total of this company's power up to 70,000 or 75,000 h.p. A contract has recently been awarded to the H. E. Talbott Company for the construction of a 1500 foot dam at a cost estimated at about $1,500,000. Much of this power will undoubtedly be used direct from the turbine shaft, but it is said that any surplus which can be transformed to electric power has already been contracted for.

Megantic to Develop Power

The Quebec Government has transferred to the town of Megantic certain water powers on the River Chaudiere, which, when developed, are estimated to give two thousand horse power. It is the intention of the town to prosecute its claim to further water powers on the Chaudiere, which will give, it is expected, at least an additional 2,000 horse power. These water powers are within seven miles of the centre of the town, and extend to the limits of the township of Gayhurst.

Exhibit of G. V. Electrics

Among the exhibits at the last automobile and truck show held in Montreal was an electric vehicle made by the General Vehicle Company, of Long Island City, N.Y. This company was represented by R. E. T. Pringle, the exhibit being in charge of Mr. J. D. Lachapelle and Mr. J. W. Mochon. A number of "G. V's" are in use in Montreal and Toronto, the Canadian Express Company having five, the Montreal Light, Heat & Power Company one, the Canadian Consolidated Rubber Company one, and Eugene Phillips Electrical Works, Limited, one.

Notice of incorporation of the Dominion Traction & Lighting Company, is given with a capital of $12,500,000. This company is empowered to carry on the business of producing and supplying gas and electricity for light, heat and power. Its privileges include the right to hold securities of other companies.

The mid-winter convention of the American Institute of Electrical Engineers will be held in the Engineering Societies' building, New York, February 26th-28th, 1913.

Regina's Municipal Railway

The Regina Municipal Railway System, operated as a public utility, now comprises approximately 14½ miles of single track, of which about 6¼ miles are paved, the remainder being ballasted. A considerable amount of the system is composed of double track with steel pole and steel bracket construction. The greater part of this mileage was installed during the year 1911, and a special portion from the post office was rushed to completion so as to give a service to the exhibition grounds during the Dominion exhibition held in Regina the latter part of 1911. During the year 1912 about four miles of single track was added to the system.

Up to the present time the passenger rolling stock has consisted of two double truck cars and ten single truck cars, all of which are kept in operation practically all the time. The cars are operated on four separate routes giving a ten to fifteen minute schedule. The two double truck cars and four of the single truck cars were supplied by the Brush Electrical Company, of Loughborough, Eng., and were the first purchased by the city. The other six single truck cars were later obtained from the Preston Car & Coach Company. These latter are equipped with Westinghouse 101-B motors and Curtiss single trucks.

The rolling stock during the latter part of 1912, however, was found to be totally inadequate, so that the city has had on order for some time eight double-truck cars, some of which have arrived, and all of which it is expected will be operating during February. These cars are being supplied by the Preston Car & Coach Company, and will bring the total of rolling stock to twenty units. These latter cars are being built according to the following specifications: length of car body, 28 ft.; length of front vestibule, 5 ft.; length of rear vestibule 7 ft.; length of car over all 41 ft.; style p.a.y.e.; single end control; Canadian Westinghouse 101-B motors and air brake equipment, and Canadian General Electric G.E. 80 motors and Brill 27 G.I. double trucks, 4 ft. 6 in. wheel base, standard gauge.

In addition to the above, eight double truck cars and six single truck cars have recently been ordered from the Preston

Fig. 1. Regina municipal railway employees

Car & Coach Company. These will have Canadian Westinghouse and Canadian General Electric equipments with Brill 27 G.I. double and 21 E single trucks, for delivery in the early spring.

The balance sheet for the year 1912 of the Regina municipal railway system contains some interesting figures. As [illegible] above the [illegible] commenced operations in July, 1911, and the revenue for the [illegible] months of [illegible] was $[illegible]. [illegible] the great advance made with one year's operations the report states that the revenue for the corresponding five months of 1912 was $[illegible],121, which is an increase of $30,117, nearly 150 per cent. The [illegible] can be shown in another way by the relative number of passengers carried. During the five months ending December 31, 1911, 167,908 passengers were moved. In spite of the fact that this included operations during the Dominion Exhibition

Fig. 2. Carbarns, with office staff and car-house employees

held in Regina in August of that year, the number has been almost trebled with one year's operation, for during the five months ending December 31, 1912, the number of passengers carried was 1,188,748.

The balance sheet for 1912 shows that after payment of all operating expenses, including fixed charges on interest and sinking fund accounts, there remains a net revenue of about $4,000, which is a very satisfactory and gratifying result. The estimated population of Regina is now in the neighborhood of 40,000. The system is at the present time carrying some 11,000 people per day, which, with ten cars in operation, is at the rate of 1,100 people per car per day.

The ticket schedule for Regina follows: [illegible] tickets 6 for 25c.; labor tickets, good 6 to 8 a.m. and [illegible] p.m., 8 for 25c.; school tickets, good any time, 10 for 25c.; [illegible] tickets in book form, 25 for $1; city employees' tickets, [illegible] for $1.50; regular cash fare, 5c.; hours of operation, 6 a.m. to 12 [illegible].

The 1913 programme calls for construction of an additional twenty-one miles of single track at an estimated cost of $550,000, with rolling stock to cost approx. $175,000. Tenders have just been called for on the material required, and as soon as the frost is out of the ground, a [illegible] will be made. It is expected that by [illegible] of the proposed programme can be carried out during the early summer, and before shortage of labor is experienced owing to the demand for laborers in the harvest fields.

Of the photographs shown herewith, Fig. 1 represents practically the entire force engaged [illegible] on this system. Fig. 2 shows a general [illegible] car barns with the office staff and the car house employees. [illegible] shows the car barns from the south [illegible] and Peteler dump cars used for [illegible]; the snow sweeper is the Preston type. [illegible] of the machine shop wit[illegible]. The total length of the car barns [illegible]. The [illegible] and store room are 75 ft. x 20 ft. [illegible] office 9 ft. x 20 ft. [illegible] employees' room 20 ft. x 20 [illegible] and [illegible] room 21 [illegible] 20 ft.

The machine shop is 75 ft. x 40 ft. with pit track in which there is installed the following equipment—one planer, one 18-in. swing double-back geared lathe, one 1½-in. bolt cutter, one pedestal emery grinder, one power hack-saw machine, one Barnes 18-in. power drill and one 10-in. hand drill. The machine shop is complete with overhead traveller, Vale & Townes block and chain, blacksmith's hearth, and all facilities for repair and maintenance work.

The car body repair shop is 50 ft. x 40 ft., containing buzzer, planer and rip-saw with pit under track. There are two fireproof oil houses, one 10 ft. x 10 ft. and the other 5 ft. x 5 ft. Another shop 25 ft. x 40 ft. contains an 18-ft. bed, 48-in. swing, McCabe two-in-one lathe, and one 150-ton wheel press. The paint shop is 50 ft. x 40 ft.

The outside buildings consist of stables, sand-drying house and a recreation and instruction room for employees, this latter being 75 ft. x 30 ft. The recreation room is for the exclusive use of employees and contains all types of parts used in the construction of passenger cars. There is also reading matter dealing with construction and operation data, useful to the employee, no matter in what part of the system he may be engaged.

Power for the system is supplied by the city electrical department, the street railway paying at the rate of 2c per kw. hour for such power as is metered to them at the power house. The equipment up to the present time consists of a 400 kw. d.c. Siemen's generator with Belliss & Morcom engine. Steam is generated at 150 lbs. pressure. The line voltage is 600. This machine has been in constant use since the 28th day of July, 1911, working on an average 19 hours per day, during which time shut downs due to fault of this equipment have been less than six hours. At the present time this unit is being duplicated, the new unit to be kept for emergency purposes.

The Regina municipal railway system owes practically all its successful operation to-day to Superintendent Doughty, who has been in the employ of the city in that capacity since the 7th of April, 1911, with the exception of a few months during 1912, when he assumed the responsi-

Fig. 3. Carbarns, snow-sweeper and dump cars

bility of the construction of the track-work for the Lethbridge municipality. This required less than five months, and Mr. Doughty returned on August 24th of last year to take up his work as superintendent at Regina again. Since that date something over four miles of track have been built and the entire system has been re-organized.

The personnel of the Regina system is as follows: city electrician and power house superintendent, E. W. Bull; superintendent of railway system, H. Doughty; general foreman, H. Baxter; chief inspector, S. E. Patterson; accountant, R. Young; chief clerk, G. Milnes; constructing engineer,

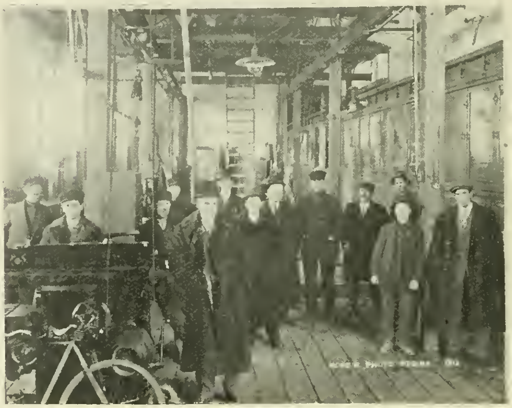


Fig. 4. Interior machine shop—Regina municipal railway

T. Brockman. The system is controlled by a commission consisting of Messrs. G. A. Mantle and L. A. Thornton.

Toronto Rejuvenation

Toronto Jovians started the month of February in real Jovian fashion, by holding perhaps their most successful rejuvenation, on Saturday evening, February 1st, in the ball room at McConkey's. All the stage settings used at the rejuvenation last fall were again brought into service, and included several very effective scenes, such as,—Jupiter's castle in the clouds, Neptune in the depths of the briny deep, Pluto in Hades, and Vulcan at his forge. A new electrical effect was introduced in the way of a crown, which was worn by Jupiter; it consisted of nine miniature flame lamps, reproducing their new emblem, the Head of Jove. All the scenic electrical effects were designed and supervised by Edwin B. Pike, Alternate Statesman. Toronto Jovians can pride themselves on the fact that no officer on the degree team carried a ritual on the stage. Morgan P. Ellis, Statesman at large, had entire charge of the degree team and floor work.

A great deal of the success of the rejuvenation was due to the manner in which all the Jovians co-operated; this was proven by the forty-two candidates, which S. C. DeWitt, chairman of the membership committee, had on hand to travel the road to Jovianism. After the initiation ceremonies an elaborate Dutch lunch was served, at which Parker H. Kemble presided.

Twin Cities get C. E. A. Convention

The Canadian Electrical Association will hold its next annual convention at the twin cities of Port Arthur and Fort William, June 23, 24 and 25. This was decided at a meeting of the managing committee held in Toronto, Friday, January 31. Very favorable transportation arrangements have been made, and a big convention is anticipated. Mr. W. L. Bird, of Fort William, general superintendent and secretary of the Kaministiqua Power Company, is president of the association.

The Montreal office of the International Engineering Works, Limited, has been changed to No. 1001 Transportation Building.

Personal Announcements

Mr. W. E. Skead has been appointed city electrician of the city of Brandon, Man.

Mr. Geo. Ostrander has been appointed superintendent of power and light in Brampton.

Mr. A. A. McQueen has been appointed assistant power engineer of the Winnipeg municipal system.

Mr. T. H. Hogg, managing editor The Canadian Engineer, has resigned to associate himself with the Hydroelectric Power Commission of Ontario.

Mr. F. A. Creighton, for several years city engineer of Prince Albert has been appointed manager of the civic hydroelectric development work at LaColle Falls, some 15 miles out from Prince Albert.

Mr. James Bennett, chief electrical inspector of the Canadian Fire Underwriters' Association, Montreal, was elected president of the Western Association of Electrical Inspectors at their convention, held at St. Louis, Mo.

Mr. Arthur H. Hull for the past three and a-half years associated with the engineering department of Smith, Kerry & Chase, has recently joined the designing engineering staff of the Hydro-electric Power Commission of Ontario.

Mr. A. Hector Dion, superintendent, the Moose Jaw Electric Railway Company, was married on January 16th to Miss Livingstone, of Listowel. Mr. and Mrs. Dion are spending their honeymoon in Europe and will return to Moose Jaw in March.

Mr. E. J. Philip, for many years in charge of electric light and power in Berlin, Ont., first with the private company and later with the municipality, has resigned to accept the position of manager of the light and power department in Brockville.

Mr. John Murphy, electrical engineer to the Board of Railway Commissioners, addressed the Toronto section of the American Institute of Electrical Engineers on Friday evening, February 7th, on the topic "A Holiday Trip to the Panama Canal Zone."

Mr. G. W. Millichamp, secretary the Chamberlain and Hookham Meter Company, underwent an operation for appendicitis some five weeks ago. For some days Mr. Millichamp's condition was most critical, but we are pleased to learn that during the last few days reports are much more favorable. We wish him a speedy return to his usual robust health.

Mr. P. H. Kemble, for the past year general sales manager of the Toronto Electric Light Company, is resigning to accept the position as manager of the commercial department of the Union Gas & Electric Company, of Cincinnati, Ohio, resignation to take effect February 18th. Mr. Kemble will be greatly missed in and around Toronto, for, during his brief sojourn in Canada he has been particularly active in promoting the interests of the electrical business. In the Canadian Electrical Association, the Toronto section of the A. I. E. E., the Sons of Jove and in his company's own section of the N. E. L. A., he has been uniformly interested and helpful and will leave many friends who wish him continued success in his larger sphere of activity.

Mr. R. J. Hiller, Montreal, has severed his connection with the Canadian General Electric Company, having accepted the position of sales manager of the Engineering Equipment & Supply Company, St. James street, Montreal. Mr. Hiller is well known throughout the Canadian electrical trade, having been identified with the industry since 1886, when he entered the employ of the Royal Electrical Company, of Montreal.

Canadian Telephone Progress

The "Compagnie Rurale de Telephone Soulanges" has been organized to operate a line of rural telephones in the highways and roads of the county of Soulanges and part of the county of Vaudreuil.

After studying the telephone systems of America and Europe, the chief electrician of the Post and Telegraph Department of New Zealand has recommended that a full automatic telephone system be installed in Auckland, Wellington, Christchurch and Dunedin.

The village of Blythe has applied to the Ontario Railway and Municipal Board for an order rescinding an agreement between the Bell Telephone Company and the rural telephone system of the township of McKillop. Under the present arrangement for inter-switching connections a double tariff is charged.

The Independent Telephone Company recently held its annual meeting at Vineland, Lincoln county, when the annual report showed that the profits for the year were about $600. The lines of this company take in Beamsville, Jordan and Silverdale. The rental to subscribers is $10 per year.

At the annual meeting of the Welland County Telephone Company held recently in Bridgeburg, it was reported that during the year one hundred new telephones had been added to the system, making a total of eight hundred and twenty five. The company now owns one hundred and twenty five miles of lines in Welland county, and this year were able to pay a dividend of 6 per cent. Mr. G. H. Pettit, Welland, is president of this company, and Mr. F. W. James, Bridgeburg, is general manager.

The Automatic Electric Company of Chicago have been awarded a contract by the Alberta Government for an automatic telephone equipment to be installed in the city of Medicine Hat. This contract provided for the immediate installation of 2,000 lines of central office equipment and 2,000 automatic telephones complete; the ultimate capacity of the exchange is to be arranged for 5,000 lines and in view of the fact that Medicine Hat is growing rapidly it is contemplated that additional equipment will be required for extensions soon after the first apparatus is installed. The work on the equipment is already under way and delivery will be made within the next 150 days. This is the fourth installation of automatic equipment to be made by the Alberta Government for public exchange service, other installations having been made in Calgary, Lethbridge and Strathcona, in addition to which the city of Edmonton operates a municipal automatic exchange.

The Auburn Power Company Development

An Installation on the Otonabee River Possessing Many Interesting Features—Another Link in the Chain of the Electric Power Company's System

By Mr. R. T. Jeffery

In the early history of power development in Peterborough, a woollen mills company obtained water rights on the Otonabee river, from the government, at a point which at that time was situated north and just outside of the city limits. A few years later a timber dam with stone piers was built at this point and the power obtained was utilized for driving a woollen mill on the east side of the river and also to generate power which was supplied to the city of Peterborough. Later, the power plant was bought out by the Auburn Power Company who operated for a number of years, utilizing water from the old Auburn woollen mill dam. The old equipment of the Auburn Power Company consisted of one 250 kw., 2,300 volt, three-phase, 60-cycle generator and exciter, one 100 kw. and one 40 kw. unit, the two latter units being 550 volt d.c. compound-wound railway generators. These were all driven by water wheel and power and light were distributed in Peterborough as well as power to the Peterborough Radial Railway Company. About three years ago the Auburn Power Company was purchased by the Electric Power Company including the water rights of the Auburn Woollen Mills Company and a larger development was planned to economically utilize the minimum flow of the river at that point. In October, 1910, work was commenced on an entirely new and up-to-date plant which was completed and placed in operation about a year ago. In the following pages we give a brief description of this plant with some of the more important details regarding its hydraulic and electrical design.

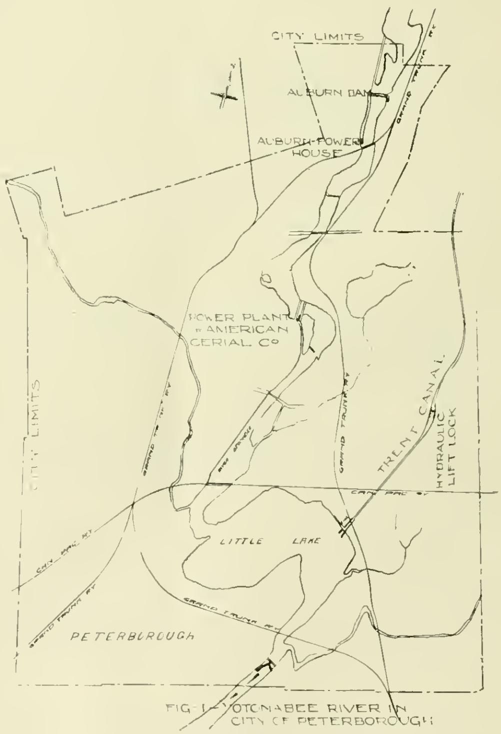
The hydraulic features of the development comprise the following: (a) main dam and intake; (b) head canal; (c) power house; (d) tail race.

Main Dam and Intake

The main dam is located opposite the Auburn woollen mills and about 1,200 feet north of the power house. It is a concrete structure consisting of piers and stop log sluices. The piers are each 6 feet thick and the sluices each 20 feet wide, with the exception of the log slide which is 9 feet on a slope of three horizontal to one vertical, with two piers, each 4 feet thick. The maximum height of the dam is 24 feet and the total length from east to west abutment is 452 feet including the intake to the head canal, which occupies a total width of 99 ft. 6 ins. at the west shore. The dam is constructed on solid limestone foundations but is designed to resist upward pressure, if water should percolate between the base and the foundations—or through the seams in the rock below. The piers are extended to the full height of the dam to provide for the construction of a street railway crossing at some time in the future, see figure. Each sluice has a depth of 10 feet below normal head water level, and thus provides a total discharging capacity of 26,000 cubic feet per second. The area of the water shed above the dam is 2,821 square miles, and the flow from this area is well regulated by the works of the Trent Canal. The area of the storage pond is approximately 20 acres. At the west end of the dam is located the intake, which consists of four stop-log openings each 20 feet wide and 10 feet deep, and separated from one another by piers 4 ft. 6 ins. thick. The total width of the platform for operating the stop logs is 14 feet. The stop logs for both intake and dam are handled by means of chain winches which can be pushed along on rails provided for this purpose.

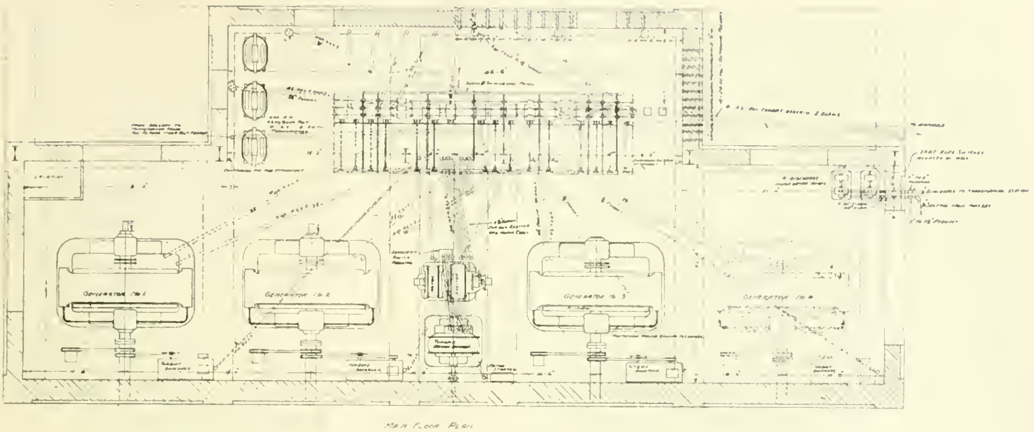
Head Canal

The total length of the head canal is 1,200 feet, and it lies parallel to the river between the dam and the power house. The excavation was made up of approximately the following qualities: solid rock, 1,453 cubic yards; loose rock, 2,270 cubic yards; common, 8,399 cubic yards. The section of the canal for some 400 feet below the head works has a solid rock bottom 74 feet wide with a concrete wall on either side. The section between 400 feet and 970 feet from the head works was common and loose and solid rock excavation and is 86 feet wide at the top. Part of this section has a solid rock bottom and the remainder is covered with 6 inches of reinforced concrete, as shown in an accompanying figure. The sides which slope 1½ to 1 are also covered with reinforced concrete 9 inches thick. The 230 foot section immediately above the power house is 83 feet wide, the bottom



Showing location Auburn power plant, Peterboro

being solid rock with concrete walls on either side. In the head race wall at the face of the racks is situated an ice run 20 feet wide, see general view, the level of which is regulated by light 3 in. x 12 in. planks. The racks are 19 ft. 7 9-16 ins. long and consist of flat steel bars 3½ in. x 5-16 in. bolted together in sections 3 ins. wide with 1¾ in. spaces between



Showing main floor plan of Auburn Power Company's development at Peterboro

bars. The upper section of the racks is of wood a special design calculated to minimize ice troubles.

A Travelling Sluice Gate

There are five wheel pits with a 3-foot wall between them. Four of these are designed for power units and in the fifth, situated in the centre of the structure, the exciter turbine unit is located. The main wheel pits are 40 feet long, 16 feet wide and 14 feet deep giving a net area at the entrance of each wheel pit of 224 square feet. The water may be cut off from the wheel pits by means of 12 in. x 12 in. stop logs, but as this operation is rather slow, and difficulty is always found in getting the stop-logs sufficiently water-tight to empty the wheel pits for repair or examination of the turbine gates or runners, a specially designed travelling sluice gate has been provided by means of which the water can be stopped off from any wheel pit in a few minutes. This gate is 15 ft. 3⅝ ins. wide and 14 ft. 3 ins. high, and is constructed of riveted boiler plate carried by a travelling gantry constructed of structural steel and mounted on four cast iron wheels 2 feet in diameter, the wheel base being 9 ft. 8 ins. and the rails a standard width 4 ft. 8½ ins. The gate itself is fitted with circulating rollers at each side to run in the concrete stop-log gains. With this arrangement it can be lifted or lowered under a full head of water with the turbine gates wide open. Leakage when the gate is closed is reduced to a minimum by means of adjustable skin side-bars which serve as guides and are set into place after the gate is closed. The gate is moved along the rails by means of a hand gear, but is arranged to be raised or lowered either electrically or by hand, and is fitted with a self-sustaining brake. It is capable of being lifted or lowered by means of the motor in 2¼ minutes against quick running water passing through the opening under the maximum head available and under the same conditions may be lowered by hand in four minutes, or lifted by hand in sixty minutes.

The Power House

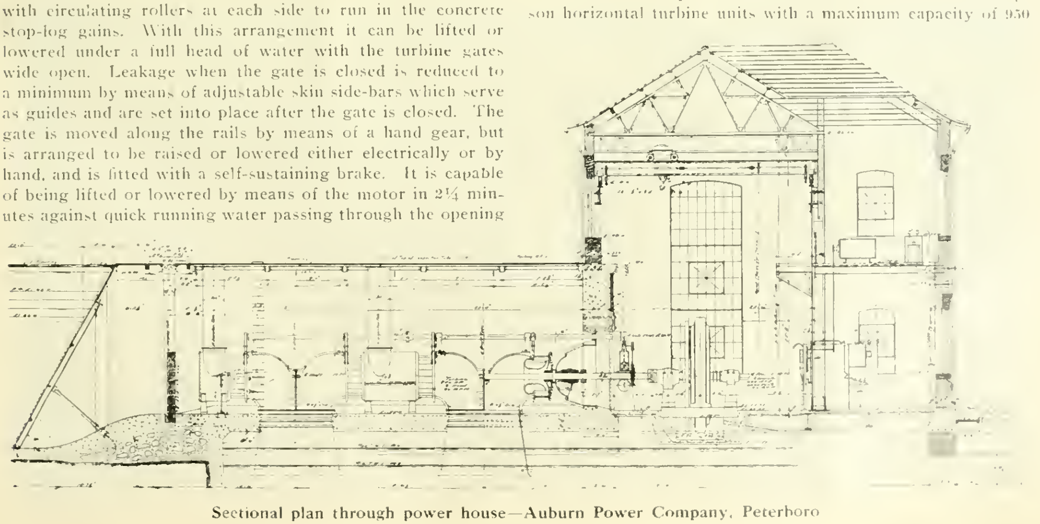
The power house substructure is composed entirely of reinforced concrete, 3,439 cubic yards being required for its construction. The inside dimensions of the power house are 88 ft. x 21 ft. 6 in. x 32 ft., with a bay in the centre of lower side of the structure 14 ft. x 46 ft. 6 ins. The roof is covered with red tile which in addition to its durable qualities adds considerably to the artistic appearance of the building.

The Tail Race

The discharge openings from the wheel pits are 16 ft. wide with 3-foot walls between them and the water may be cut off from the wheel pits by means of 12 in. x 12 in. stop logs. The tail race is approximately 250 feet long and is a rock excavation. The tail race passes under the G. T. Railway bridge just before it joins the river.

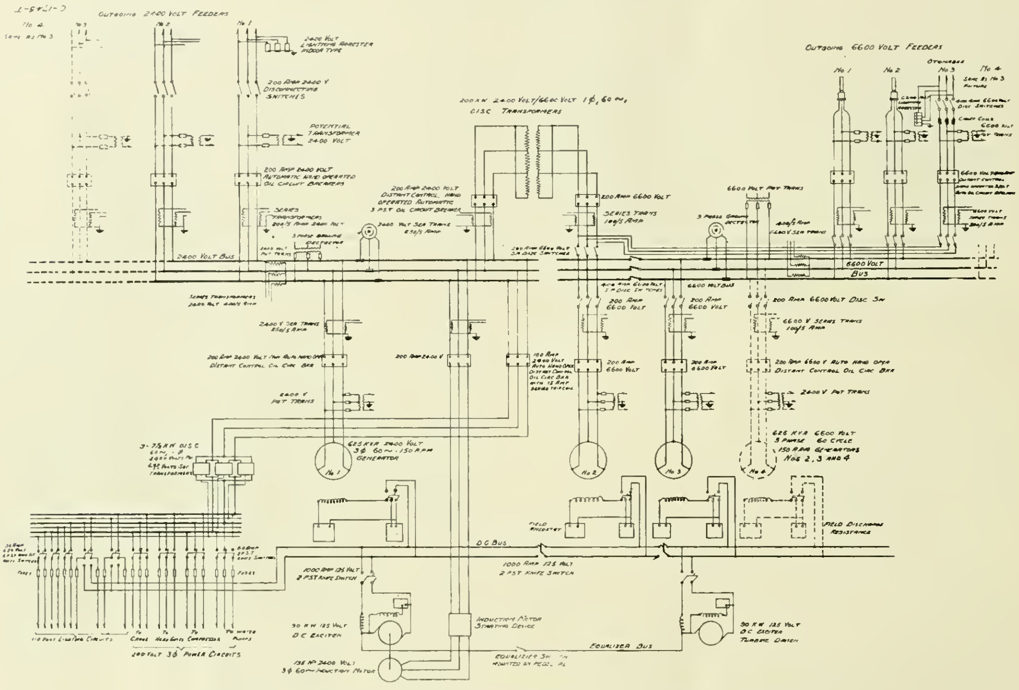
Hydraulic Equipment

There are at present installed three four runner Sampson horizontal turbine units with a maximum capacity of 950



Sectional plan through power house—Auburn Power Company, Peterboro

h.p. at 18 feet head and 150 r.p.m. having a maximum efficiency at 700 h.p. The guaranteed efficiency is 80 per cent. at 7/8 gate, 82½ per cent. at ¾ gate, 82½ per cent. at ½ gate, and 73 per cent. for ¼ gate. After the turbines were installed they were tested for capacity at normal head and efficiency at various gate openings. In making these tests, a suitable load was obtained by the use of a 6,600 volt water rheostat located in the tail race and the water which passed through the turbine was measured at the stop log gains in the tail race by means of a Price current meter.



Wiring diagram—Auburn Power Company's generating station, Peterboro

The turbine runners consist of steel plates, the gates and guides of cast iron, the draught tube ring of cast iron, and the draught tube of steel plate. The bearings are lignum vitae, and babbit ring oiled type. Each unit has two cylindrical inspection tubes with a step ladder fastened to the inside to permit of the bearings being easily inspected.

The exciter turbine consists of two 26-in. Sampson runners mounted on a horizontal shaft and is capable of delivering 170 h.p. at the generator coupling at full gate when operating under 18 feet head and at normal speed of 275 r.p.m. The runaway speed of the turbine is 425 r.p.m., and the efficiency at full gate 80 per cent.; at ¾ to 7/8 gate approximately 82 per cent. There is no governor on this unit, and the maximum pull on the hand wheel required to open and close the gates completely is 40 lbs.

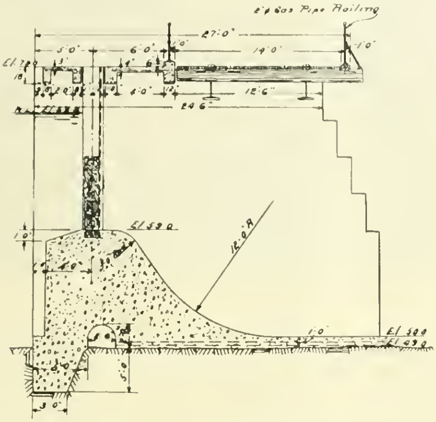
The speed of each of the 950 h.p. turbines is regulated by a governor supplied by the Lombard Governor Company. The piston of the governor is connected directly to the turbine gate shaft by means of a connecting rod and crank, without intermediate gears, and the governor is capable of moving the gates of the turbine through their full range, either opening or closing in two seconds. The governors are also supplied with a device which will close the gates automatically should the governor belt break or any accident happen to the pump, and will readjust the gate opening if the speed varies more than ½ of 1 per cent. from normal. The maximum energy given by the governor in opening or closing the gates is 17,000 foot-pounds. Each governor is supplied with a control motor and also a control switch located in the generator panel by means of which the station operator is able to control the speed of the unit close enough for synchronizing the generators. All the turbines were supplied by the Wm. Hamilton Company of Peterborough.

Electrical Equipment

The generators were provided by the Canadian General Electric Company. No. 1 unit is a 625 kv.a. unit wound for 3-phase, 60 cycle, 2,400 volt operation at a normal speed of 150 r.p.m. The other two units are of the same capacity as No. 1, but are wound for 3-phase, 60 cycle, 6,600 volt operation at a normal speed of 150 r.p.m. A full load efficiency of 94.4 per cent., regulation of 6 per cent., at 100 per cent. p.f., and temperature rise of 40 deg. C. at 80 per cent. p.f. is guaranteed by the manufacturers. The rotor consists of a cast steel spider with a forged steel rim to which the field poles are bolted. The specified fly-wheel effect of the generators is 400,000 lbs. feet, and in order to reach this figure a fly-wheel was keyed to the shaft close to the rotor. Placing the fly-wheel in this position inside of the generator base, saves considerable floor space. The generators were given a runaway speed test in the factory at 255 r.p.m. for 15 minutes, with full load field current at 80 per cent. p.f.

After the generators were installed heat runs were made on each unit at full load and 80 per cent. p.f. and also at 1¼ full load 80 per cent. p.f. The load was obtained by means of the 6,600 volt water rheostat located in the tail race, and

the proper power-factor was obtained by running one of the other generators in parallel with the generator being tested as a synchronous motor and varying its field to get the required power-factor. These tests showed the temperature rise of generators to be well within the contractors' guarantees.



Section through spillway of main dam—note railway tracks

Exciters

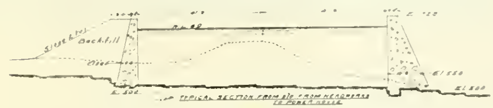
There are two exciter units of Swedish General Electric type supplied by Messrs. Kilmer, Pullen and Burnham. One consists of a 90 kw., 125 volt, 275 r.p.m. compound-wound, horizontal shaft, water-wheel type generator. The other unit is a motor-generator set consisting of a 90 kw., 125 volt, 860 r.p.m. compound-wound d.c. generator, direct connected to a 135 h.p., 3-phase, 2,400 volt, 60 cycle slip-ring type induction motor, the set having two ring oiled bearings. Both these sets are guaranteed by the manufacturers to carry full load with a temperature rise not exceeding 40 deg. C., and tests after installation showed that they will operate well within these values.

Switching Equipment

The switching equipment was supplied by the Canadian General Electric Company. All the panels are of blue Vermont marble, and the 2,400 volt and 6,600 volt busbars, current and potential transformers, feeder disconnecting switches and oil switches are mounted on a pipe frame work structure behind the switchboard with a passage way between. The instrument wiring is carried to the panels in conduit, making a very safe installation as no voltage higher than 125 volts

Typical section of head canal, Peterboro

is brought to the switchboard. Wooden gratings laid on rubber mats are placed on the floor at the front and rear of the pipe bus structure, and rubber mats in front of the switchboard. All instrument covers, oil switch tanks, pipe



Typical section of head canal, Peterboro

frame work, cable sheaths and bells, and generator frames are thoroughly grounded.

Situated at the west end of the switch bay are three 200 kv.a., 6,600-6,300-6,000/2,400-2,300-2,200-600 volt single-phase self-cooled transformers. The primaries are wound so that they can be connected in delta or Y and when Y connected can be operated from an 11,000 volt circuit.

The 2,400 volt generator is connected so as to feed the north end of the city in the vicinity of the station at 2,400 volts and the three 200 kv.a. 6,600/2,400 volt transformers are so connected between the 2,400 and 6,600 volt busses that this generator may be used to supply power to the 6,600 volt busses through these transformers as well as to the local distribution system at 2,400 volts. With this arrangement 1,000 kw. may be fed out of the station to the local distribution system at 2,400 volts, or the total output of the station may be fed out at 6,600 volts to the 44,000 volt transformer to be stepped up to the transmission line voltage. The

Interior Auburn Power Company's generating station, Peterboro

A General view of the Auburn Power Company's generating plant, showing head canal,

generators are connected to the oil switches through lead covered cable and they may be synchronized at the switchboard by means of the motor-operated governors.

The plant of the Otonabee Power Company which is situated a few miles further up the river and is owned by the Electric Power Company, is run in parallel with the Auburn station as is the plant of the American Cereal Company from which the Electric Power Company purchase a block of power at 2,400 volts, as well as power to drive a 200 kw. and a 100 kw. 500 volt d.c. belted railway generator to operate the electric railway of the Peterborough Radial Railway Company. These railway generators are situated in the power house of the Cereal company and are each belted to one of the a.c. units.

Transformer Station

From the 6,600 volt busses feeders in lead-covered cable run to the transformers station where the power is stepped up to 44,000 volts and transmitted over a single circuit, 3-phase, 4/0 aluminium line to Port Hope, where the h.t. line is tied in with the remainder of the Electric Power Company's system. The transformer building has three pockets 12 ft. 6 ins. x 12 ft. with a 14-in. wall between the pockets 21 ft. high. The lightning arresters and h.t. oil switch are located at the north end of the building through which wall the h.t lines pass to the switch tower of the h.t. line. The h.t. bus-bars run up over and across the wall between the transformer pockets and are supported on insulators. On the east side of the building is an extension 11 feet wide by 30 feet long, in which are located the oil tank and water filters.

Switchboard, busstructure and gallery

The substructure of the transformer building is concrete while the superstructure is structural steel and pressed brick. The roof is concrete covered with a roofing compound. There is no crane supplied for lifting the transformer core and coils out of the tanks, the idea being to construct a track leading from the front of the transformer building to the power house. When it is necessary to disassemble one of the transformers it will be run out of the pocket on to a special truck which has been designed for that purpose and run down to the power house, where it can be disassembled on the erecting floor of the generating station. This scheme permitted the transformer building being made very much narrower and lower than it would have been had it been designed with an erecting floor and crane. There are at present installed two 1875 kv.a. 6,600-6,300-6,000/44,000-42,000-40,000-38,000 volt O.I.W.C. transformers. These transformers were supplied by the Canadian General Electric Company and have a guaranteed temperature rise of 40 deg. C. at full load. One of these transformers is at present being used as a spare.

Auburn transformer station

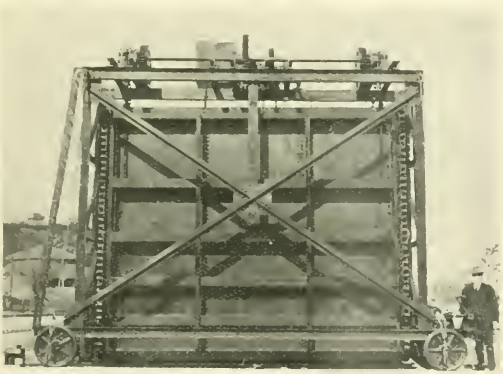
That part of Peterborough that is not being supplied with 2,400 volts power direct from the generating station is supplied from the Otonabee sub-station in which are installed 6-250 kv.a., 6,000/2,300 volt oil insulated, self-cooled transformers, and one 750 kv.a., 6,600-6,300-6,000/2,400-2,300-2,200-

...y, sluice gate, power house, tail race and transformer house in background

600 volt oil insulated, self-cooled transformer.

It will be seen that with the above described connection, Peterborough is sure of an excellent service from the local plant, and in addition is also connected in with the Electric Power Company's system through the h.t. line which runs to Port Hope.

The construction works in connection with installing the plant was done by the Midland Construction Company. The sub-contractors in the general works were Clarke &



Emergency sluice gate, Peterboro

Monds, Trenton, and on the structural steel work Mackinnon, Holmes & Company, Sherbrooke, Que. The work was done according to the designs and under the supervision of Messrs. Smith, Kerry & Chace, consulting and operating engineers of the Electric Power Company.

Third and Fourth Reports

The third and fourth annual reports of the Hydro-electric Power Commission of the province of Ontario for the year ending October 31st, 1911, is just to hand. The reports outline the results that had been accomplished to that date under the following headings: 1. Acts and agreements; 2. Transmission system; 3. Construction of stations; 4. Operation of systems; 5. Hydraulic investigations; 6. Municipal work. In addition to a quantity of valuable information the reports contain some forty-five excellent illustrations of the Commission's system.

New Features in Drum Type Controllers

Sometimes the location of drum controllers makes operation by a straight backward and forward motion of the operating handle a little more convenient than the usual rotary motion in a horizontal plane. The Cutler-Hammer Manufacturing Company, Milwaukee, have, therefore, standardized a vertical arrangement of lever with bevel gear drive that can be applied to the six different current types of enclosed drum controllers and the three alternating current types. The accompanying illustration shows this straight line drive, the lever having a centering latch released by means of the button at the end of the handle as in the case of the horizontal rotating type lever. The operation is very easy and the milled star wheel and notched lever permit all points of control to be distinctly felt. The construction of the drum, non-stubbing fingers, arc deflectors, cylinder, etc., remains as in the original line of controllers which was brought out about two years ago. Special arrangements can also be made for rope operation.

The Oshkosh Manufacturing Company, in order to take care of their rapidly increasing business in Indiana and Illinois, have opened a branch house at 410 426 South Clinton street, Chicago. It is felt that this will be a great convenience to Chicago customers as the new branch will carry a complete line of the well-known Oshkosh tools. This branch house will be in charge of Mr. R. L. Thayer.

James Beggs & Company, 36 Warren street, New York, announce that over 600,000 horse power of Blackburn-Smith Feed Water Filters and Grease Extractors are now in service.

Lightning Troubles on High Tension Lines

A Discussion of the Effect of Lightning Discharges with an Argument in Favor of the Condenser Type of Arrester—The Mosciki Condenser

By Mr. N. W. Lofvengren

The expression "lightning troubles" is hardly correct, as in general the trouble referred to can be either atmospheric or from an internal creation on the system. The troubles met with in practice are, (a) static troubles, and (b) atmospheric surges.

Static Trouble

This trouble is due to wind, rain, sleet, etc., creating an accumulation of static electricity in various portions of the lines, and the voltage continually mounts until it reaches such a point that it is able to puncture the insulators supporting the lines. It is of a continuous current nature, and these accumulations of electricity can occur at several places on the line, and from a variety of causes, such as already mentioned, the friction from wind or sleet, big differences of elevation when the line passes through a valley and then over a mountain, differences of temperature between sunrise and sunset, etc. These troubles, we find, are not particularly common in Canada, but in such places as Mexico, California, etc., much trouble is met with in this respect.

Again, where the line passes over a well timbered country with good earths from rivers or loamy soil, this danger is considerably lessened. Where the line is perched on high and dry rocky ground, quartz or otherwise, with bare earths, this trouble can become very dangerous, and also where the line passes through long reaches of very dry sandy prairie land, which means bad earths and little means for the disposition of the accumulation of static electricity.

The proper course to take to protect against this trouble is to connect the line to a permanent path for the passage of this accumulation, which should be, therefore, a path of very low resistance, thus permitting the easy passage of the continuous current (in other words the accumulated static electricity), but not permitting any appreciable quantity of current at the ordinary periodicity of (say) 25 to 60 cycles. The only apparatus that can do this is one whose resistance increases as the periodicity, making use of the well-known principle of induction. Such an apparatus consists of a choking coil wound on an iron core, immersed in oil, with one terminal to connect to the line, and the other to connect to the earth.

Before proceeding, it must be borne in mind that this apparatus has nothing to do with the choke coil in series on the line as the principle of the line choke coil is quite different. This inductance coil does not carry the main line current at all, and is arranged to have a big choking effort to prevent the flowing of any line current. At the same time, the low ohmic resistance allows an easy passage direct to earth for the flowing of the continuous current which accumulates on the line and prevents a rise to any big potentials.

In regard to the installation of these coils they should be placed, of course, at points where there is liable to be any big potential accumulations, such as at the lower end of the line in a valley and the higher end of the line on top of the mountain, or, say, in prairie land between mile sections and always, of course, at the sub-station or power station.

The installations in the sub-stations and power houses are usually sufficient in Canada, where, being fairly well wooded in the general run of cases, with good earths, it means a big saving as regards trouble from this source.

This trouble is generally the most serious in all countries, and certainly is in Canada. It is the result of atmospheric storms, and causes the breakdown of machinery far more than of line insulators, for reasons given below.

In the first place, let it be understood that the condenser type of lightning arrester does not protect against a direct stroke on the line, nor is there any apparatus on the market that does protect against a direct stroke. A direct stroke is not particularly dangerous to the apparatus in the station, insofar as its effect is strictly local, shattering insulators, overthrowing poles, etc., but not proceeding along the line to the station.

The High Frequency Surge

The most dangerous phenomenon is the comparatively low voltage, high-frequency surge that is set up when a discharge occurs between neighboring clouds or between clouds and earth, in a direction more or less parallel to the line. This atmospheric discharge is of an oscillatory nature, similar to the discharge that occurs in the Leyden jar, and the oscillations are of an extremely high frequency and induce in the line a secondary high frequency surge. Besides the ordinary oscillographic measurements, this is proved in many ways, as for example, in the interference of atmospheric storms with wireless telegraphic apparatus. During an atmospheric storm, signals are received by wireless receivers of an obviously atmospheric nature—so much so on many occasions as to exclude the possibility of ordinary signals being transmitted,—and seeing that the apparatus used with regard to wireless work is only tuned to periodicities of 100,000 to 1,000,000, and cannot respond to periodicities either below or above, it is obvious that these interferences must be of some intermediate frequency.

Again, a condenser which cannot pass appreciable currents except at periodicities greater than 100,000 has been connected to lines, and a fuse placed in series with the condenser. On the occasion of a heavy atmospheric discharge, as much as a 40 amp. fuse has been blown, and seeing that, to allow 40 amps. to pass, the frequency of the current to get through the condenser must have been at least 250,000 (resistance of a condenser varies inversely as the frequency) it is obvious that atmospheric disturbances are of a high frequency nature. There are many other proofs of this.

To continue, assume that, due to a discharge between clouds, high frequency surges have been created in the line and are propagated along until they reach the sub-station or a generating station, as the case may be. During their propagation along the line, they, of course, gradually use up their energy and the amplitudes of the waves are gradually decreased. If the point of creation is more than fifteen to twenty miles from the station, in all probability the surges will have become so flattened down as not to be dangerous to the gear inside the station, and the energy of the surge will have expended itself in the ohmic resistance of the line and also the skin effect, which, of course, is a very great item when dealing with high frequency currents.

Assuming, however, the point of creation is considerably closer,—say one or two miles from the station—the surge tension reaches the station with quite a large voltage of, say, a maximum of 3,000 or 4,000 volts on a 13,000 volt line, for example. Now this surge tension being so much lower than that for which a 13,000 volt arrester would be set (the setting is generally 15,000 volts), it cannot get across

the horns or gaps, whichever may be used, according to the type of so-called arresters. This surge tension, however, continues on, sparks across or passes through the choke coils (according to the type—see notes later on), and reaches the terminal of, say, the transformer. Now the windings of a transformer simply constitute an ordinary condenser (in which the ohmic resistance can be neglected) in-so-far that one has copper, insulation, and then iron core—that is, two conductors with insulation in between. The whole length of winding, of course, constitutes the total capacity to earth of the transformer, and it can be proved that the conductivity to earth of the transformer is equal to $\sqrt{(L/C)}$ where

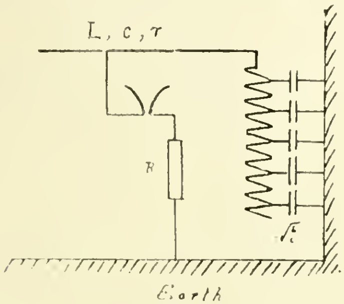


Fig. 1

L equals the inductance in henrys and C the capacity in microfarads of the winding.

Now owing to the high frequency nature of the current, it is absolutely impossible for it to penetrate the turns very far, and it generally localizes itself on the first, second or third turns. This means that the only passage to earth, then, is that given by the first few end turns.

Now, the frequency of this surge tension being so high, the wave length, is very very small, and between two or three turns there occurs a maximum positive and maximum negative of surge tension, and if the amplitude of the surge tension is 2,000 volts, this means that between two or three turns we get a difference of potential of 4,000 volts. Now though the end turns of a transformer are usually wound with extra heavy insulation to stand surges between turns, and normally the turns between windings should carry a difference of voltage of say 20 or 30, with the extra insulation we will allow them to carry three or four times as much and say, therefore, that they are supposed to be able to withstand 100 volts between turns. In any case, it is seen how utterly useless this is, as 4,000 volts are just about as dangerous when applied to turns which normally can withstand 100 as when applied to turns which can only withstand 20 or 30. It means the insulation is punctured in any case, and after two or three recurrences of this puncture the insulation will be so weakened that on the next occasion line current will flow, and a burn out results, and down goes the end coil of the transformer or alternator, as the case may be.

Operation of Arresters Valueless

It may be argued that the arresters have been seen to discharge, which we will admit, and we will take the case, of an arrester, whether of the horn with resistance in series, the multigap or the electrolytic type, in operation, and prove that usually the operation is valueless.

Assuming that the voltage of the surge tension was sufficient to get across the gap, it is at once seen that we have two paths in parallel for a discharge to earth—one through the arrester and one through the winding of the machine, as described above. We attach herewith the algebraic expressions, showing the results of the two paths connected in parallel, and the total conductivity thereof, and the reduction coefficient is given finally by the expression

$$\frac{R}{\sqrt{(L/C)} + R}$$

where R equals the resistance in series with the arrester and $\sqrt{(L/C)}$ is as given above (See Fig. 1). This can be demonstrated as follows:—

It has been shown that as regards the transmission of waves, a line is equivalent to an ohmic resistance of the value $\sqrt{(L/C)}$. When an oscillatory current I_1 flows, the surge tension is given by $I_1\sqrt{(L/C)}$. Assuming the arresters have operated, there are two paths in parallel for conducting the discharge, of resistance R for arrester, and $\sqrt{(L/C)}$ for machine. The total equivalent resistance, therefore is

$$\frac{R\sqrt{(L/C)}}{R + \sqrt{(L/C)}}$$

so for a current I_1 flowing to earth by two parallel paths, the surge tension becomes

$$I_1\sqrt{(L/C)} \times \frac{R}{R + \sqrt{(L/C)}}$$

and the reduction is given by the factor

$$\frac{R}{R + \sqrt{(L/C)}}$$

By practical measurement $\sqrt{(L/C)}$ is always equal to approximately 600 ohms. Therefore the reduction coefficient equals

$$\frac{R}{600 + R}$$

Now in considering the resistance which is permissible to be in series with horns, it must be borne in mind that we must not have the resistance too low as it would pass considerable line current, and if very low would practically constitute a short circuit to earth. This, of course, is obviously inadvisable. We must have, therefore, the resistance high enough to prevent the excessive line current flowing to earth, and also to prevent a second phenomenon of resonance.

Now resonance occurs when we have fairly high inductance, high capacity, and low ohmic resistance. With the winding of the transformer, therefore, and high frequency current, we have a tremendous inductance, and as already explained, only utilizing a very little insulation resistance at the end turns, we have a very high capacity. These, combined with the resistance in series, including, say, a low resistance arrester sets up resonance, or in other words a high frequency surge of the very nature we wish to avoid

This has often been demonstrated—for example, in south-western Ontario, where they use horn gaps with oil immersed resistance—and on the occasion of a lightning discharge the arresters operate three or four times in succession very rapidly. Now the discharge from lightning only occurs once so that the next two or three times is simply the result of resonance, and the re-establishment of the arc itself This is also often noticed in the charging of electrolytic arresters, where, after charging, the current is finally ruptured on the horns and the abrupt rupture sends oscillations up and down the line, on occasion causing the circuit breaker to trip, as has occurred at various points in Ontario. The reason for this is given later.

In any case, it can be mathematically proved that the resistance in series with an arrester must be greater than twice $\sqrt{(L/C)}$, as follows:—

Assume V equal to the voltage for which the arrester is set, and E equals the nominal line voltage. V equals aE where a is a constant. When the apparatus operates the

current I flowing is expressed by $I = V/R$ and surge tension when this breaks is

$$I \sqrt{(L/C)} = \frac{V \sqrt{(L/C)}}{R}$$

To avoid the possibility of creating a surge tension big enough to re-establish the arc, the following must be fulfilled

$$\frac{V \sqrt{(L/C)}}{R}$$

must be less than V (the setting voltage).

Therefore R must be greater than $\sqrt{(L/C)}$.

Owing to the uncertainty of the value of $\sqrt{(L/C)}$, and in order to provide against the above, R must be greater than $2 \sqrt{(L/C)}$.

Take a 1,000 kv.a. station, 10,000 volts, and R equal to 2,000 ohms using the formula

$$\frac{R}{R + 600}$$

For R = 2,000 ohms, reduction coefficient = 0.77
For R = 3,000 ohms, reduction coefficient = .83
For R = 5,000 ohms, reduction coefficient = .90
For R = 10,000 ohms, reduction coefficient = .94

Owing to the uncertainty of $\sqrt{(L/C)}$ this resistance must never really be taken less than 2,000 ohms, say for a 10,000 volt line, and even this figure constitutes a pretty dangerous feature. With this figure, therefore, and R equal to 2,000 ohms, we have worked out the reduction coefficients and it is seen, that the modification of the surge tension is 23 per cent., 17 per cent., etc., down to practically nothing at all. This modification is utterly valueless as 3,000 volts are just as dangerous when applied between turns which should only carry twenty or thirty, as is 4,000 volts. It is only on very rare occasions too that a modification of 23 per cent. of the surge tension occurs, and practice proves that the modification is rarely above 5 per cent. to 10 per cent.

Proper Apparatus a Condenser

The only apparatus, therefore, that is theoretically and practically correct is one whose resistance varies inversely as the frequency. That is to say, for low periodicity and continuous current, there is no line current passing, but on the super-position of a high frequency surge from any cause whatsoever, the apparatus presents a good easy path to earth. The only apparatus that fulfills this condition is an ordinary condenser.

The difficulty in past years has been the successful design of these condensers, to avoid excessive heating, due to continual connection to the line, and various other things. In the "Mosciki" condenser the problem has been successfully solved, and the condensers can be connected to the line without more than four or five degrees C. rise.

These condensers consist of a hydraulic flint glass tube, with a neck narrowed at one end, about 30 ins. long, and 2 in. diameter, silverplated inside and outside, and reinforced with a copper plating outside the silver. A suitable insulator is mounted on the narrow end and connections taken to the internal coat. The external coat is connected to the earth frame of the apparatus. The whole tube is fitted in a block brass tube, and is hermetically sealed, so that there is nothing visible but the insulator. The block brass tube is filled with a mixture of glycerine and water, so as to uniformly distribute all heat due to di-electric hysteresis. Several of these tubes are mounted in parallel, according to the size of the station to be protected, but the minimum is six, and the maximum 24. These condensers have been successfully built and operated continuously on lines up to 60,000 volts.

Each condenser tube has its own fuse, so that should one get a particularly heavy discharge, its fuse will blow. It is practically impossible for more than one fuse to blow at a time, and we might add that it is a very rare occurrence when these fuses do blow—say only once or twice a year during an exceptionally heavy storm. It is, of course, advisable to have some periodic inspection and cleaning, which is necessary with any electrical apparatus. The blowing of one fuse however does not put the apparatus out of commission, and only means that until the fuse is replaced, the other tubes have slightly heavier duty. For the ordinary discharge one tube is amply sufficient, so that there is a factor of safety of at least six and on many occasions considerably more, and a fuse is really only a protection for the apparatus itself, preventing its being punctured on the occasion of excessive discharge. As already mentioned, it is only on very rare occasions that the fuses are ruptured.

In conjunction with this arrester choke coils are used, which again are slightly different from the usual make. They are of course helical in construction, and not disc type, for the disc type choke coil is utterly valueless. It is at once seen that in the disc type choke coil there are layers of copper and insulation, simply forming the equivalent of a condenser and high frequency surges coming in from the line, strike the outer layer and are propagated, as under ordinary conditions in a condenser, through the metal and insulation to the centre, so that there is absolutely no choke effect at all. In fact they constitute little more than the equivalent of a resistance in series with the line so far as the high frequency surges are concerned.

The helical type of choke coil as adopted by the General Electric and Westinghouse is, we believe, correct, and the Mosciki design is the same, except that they go one step further, and instead of using copper or aluminium wire, utilize iron wire, so as to take advantage of the higher resistance—the greater skin effect of iron and the magnetic properties all combining to give a far bigger reflective effort on the line. The coils, of course, are proportioned suitably to carry the line current, and again one need not fear that there is any excessive volt drop under ordinary working conditions, as this volt drop is dependent entirely on the impedance over normal frequencies. These coils have a slightly less impedance than those of other makers, and therefore the voltage drop is rather less than with other makes.

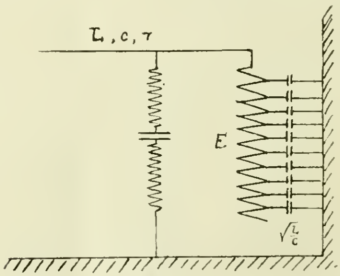


Fig. 2

Another point is the isolating of the arresters from the line during inspection, cleaning, etc., and one must fully appreciate the fact that a capacity circuit must not be abruptly disconnected from the line. This often causes great trouble, as in the case of the electrolytic condenser during charging. There is, therefore, supplied with these arresters slow break switches, which slowly disconnect the apparatus from the line through a gradually increasing resistance of a mixture of water and glycerine.

The Effect of a Battery of Condensers Placed Between Line and Earth

In Fig. 2 is represented a line, having self induction, capacity and kilometric resistance (L.c.r.) the winding of a

machine E and a lightning arrester in the form of a condenser having the capacity g and connected to earth through a wire having the self induction d and an earthplate with the resistance p. We have again to calculate the equivalent resistance of these two paths to earth.

The calculation is often employed in telegraph and telephone work, but we content ourselves with simply giving the result of this calculation. We have examined different cases according to the value of the resistances presented by the earth-plates, and according to the self-induction of the earth wire and we give below a table which shows the reduction coefficients for discharges having frequencies be-

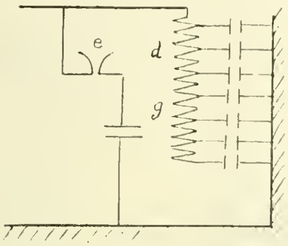


Fig. 3

tween 100,000 and 1,000,000, assuming that the condenser battery is one of our standards with twelve tubes.

Resistance of Earth Wire	Self-Induction of Earth Wire	Reduction Coefficient at different Frequencies 100,000	250,000	500,000	1,000,000
0	0	0.067	0.027	0.013	0.007
5	$2/10^6$ henrys	0.065	0.024	0.009	0.016
5	$2/10^5$ henrys	0.041	0.028	0.092	0.205
50	$2/10^5$ henrys	0.093	0.087	0.128	0.225

An examination of this table shows us that we no longer deal with a reduction to about two-thirds of the original surge tensions, as was the case with horn arresters, but that we easily arrive at such enormous reductions that only from 2 per cent. to 6 per cent. of the surge tension remains if there is a good earth plate and if the self induction of the earth wire is small. To reduce such a condenser battery to a similar low efficiency to the horn arrester, the frequency would have to be as low as 2,000 periods and we have shown that at this periodicity, surge tensions are no longer any source of danger. The table also clearly shows the very great importance of minimising the resistance of the earthplate and the self-induction of the earth wire, and this leads us to the conclusion that the majority of installations of protective apparatus have greatly failed on these points

It is not necessary, as stated by several persons, that the capacity necessary for protective purposes should be of the order of that of the line; it must only be taken somewhat higher than the capacity of that portion of the line which corresponds to a half wave-length of the high frequency wave. With a frequency of 100,000 periods, for example, we need only consider the capacity of 1,500 meters of line, and for a frequency of 1,000,000 periods that of 150 meters; the protection is evidently the same for a line of 100 km. length as for a line of only 10 km. length, because we deal here with forced oscillations and not with free oscillations.

It has also been stated that it was dangerous to place condensers on the line because, in that way, the capacity of the line was increased, but if this were the case, one should never construct overhead lines which have more than .01 mf. per kilometer, and cables which have .2 mf. or twenty times as much would be impossible. From this point of view it would not be permissible to increase the length of any given overhead transmission because an additional 5 km. of overhead line or 200 meters of cable would correspond in capacity to one of our condenser batteries.

Observations on the Electrolytic Condenser with Spark Gaps

From Fig. 3 it may be seen that as soon as the spark gap operates, we have a resonance circuit constituted by the condenser, the gap and the winding, which of course is a very dangerous arrangement and also retains the disadvantage of horn arresters, viz., that it cannot came into operation before the high frequency tension has attained a value corresponding to the adjustment of the arrester. A great deal has recently been published concerning the employment of an electrolytic condenser for protective purposes. This device consists of a number of electrolytic condenser elements arranged in series, each element being formed by two suitably shaped aluminium discs which are separated by the electrolyte. For pressures which are below the "forming" pressure the system acts like a condenser; for higher pressure, the condenser punctures and acts like a capacity shunted by an ohmic resistance. When the pressure becomes reduced again the electrolytic condenser automatically reforms. If therefore the tension increases much above that which is normal, this kind of condenser is entirely broken through and the resistance R in Fig. 4 is then only the resistance of the electrolyte. As soon as the surge tension has disappeared the condenser begins to form up again and the resistance increases until it attains an almost infinite value.

One can imagine the three following possibilities with this arrangement, Fig. 4.:—

1. When the arc breaks and the value R is infinite, the apparatus acts like a condenser with a spark gap in series, and produces resonance effects because no appreciable ohmic resistance is arranged between the condenser and earth.

2. When the condenser has broken through owing to the surge tension, and is not reformed when the arc breaks, the resistance R, being practically that of the electrolyte, is very weak and the conditions are as though a short circuit to earth had been broken. If I is the value of this current, the resulting surge tension will be $I\sqrt{(d/g)}$ which may be an extremely high voltage.

3. If the condenser has broken through owing to the surge tension and is only partially formed up again when the arc breaks, the resistance R may have any value. If it is very small, that is to say only a few tens of ohms, we have practically the preceding case; if it is larger, that is to say a few 100 ohms, then the condenser still operates as a badly

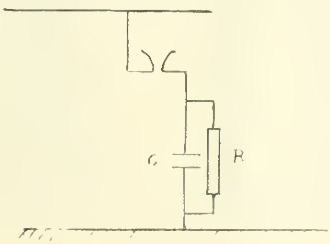


Fig. 4

insulated condenser and produces resonances. It therefore follows that the apparatus is always dangerous. It would not be the same if it could be connected to the line without a spark gap in series, but this cannot be done because electrolytic condensers rapidly deteriorate under alternating pressure.

Another great disadvantage with these electrolytic condensers is the necessity of "forming" them every day by connecting them for a few seconds to the line.

While the above described condenser is suitable for high frequency currents it is not equally applicable to

medium frequency discharges and another type of apparatus known as the Giles Valve has been devised to take care of discharges under the more moderate conditions. This trouble is one that is created internally on a system, due to hunting of machinery, the abrupt opening of a circuit breaker, the sudden charging of a cable, etc. These troubles are generally more in evidence when a wave form contains the third and fifth harmonic. These frequencies, of course, are much too low to enable us to use a condenser, and in the ordinary way the usual tension limiter is utilized, which consists of a gap with a resistance in series. Now the same arguments apply with regard to this tension limiter as given to the above arresters, namely, that if the resistance is made too low, a danger of resonance is constituted, creating the very trouble you wish to avoid and if too high, the effectiveness is very very limited, and not at all valuable. The apparatus used, therefore, is a spark gap, with resistance connected to earth through condensers. This allows the setting of the gap to within one or two per cent. of the line voltage if necessary. It also enables the use of comparatively little wire as there are several elements in parallel. On the occasion of a potential rise at the terminals of a generator or cable, a discharge occurs, current passing down through the resistance wire, and charging up the first plate of the condenser. The moment a plate of this condenser reaches any big pressure, it sparks across to the next condenser, and the same action is repeated until finally the earthed plate is reached, when the energy expended in the various spark gaps, etc., by the two or three elements in parallel prevent an abnormal rise.

The great advantage of utilizing these condensers is that during every half period the arc is absolutely extinguished, and needs no accessory apparatus to blow the arc out. Also, there is absolutely no possibility of the arc hanging on in the main spark gap, as the resistance is not connected directly to earth, but through a series of small condensers, which in themselves have a big insulation resistance. It is only the sparking over of the edges of these plates which gives the connection to earth and at the same time automatically extinguishes it when the wave passes through a point of zero potential. Under these conditions the Giles Valve is surprisingly effective and reliable.

In Fig. 5, the winding of an alternator is shown diagramatically with its capacity against the frame uniformly distributed. I, I, denotes a double pole automatic oil

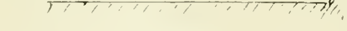


Fig. 5

switch. Assume that the alternator feeds on a line on which a short circuit develops. At this moment the alternator produces a current in this short circuit which is approximately three times the normal current. In the case of turbo alternators, this short circuit current may amount to 30 to 40 times the normal current.

If we denote by l the induction of the alternator, by I the normal current and by I_1 the short circuit current, then the energy which is stored in the winding of the alternator will be $\frac{1}{2}$ l I_1^2.

Since the automatic switch breaks this circuit suddenly, it follows that this stored energy will not have time to flow off through the line and a surge tension is the result because the only path through which this energy can flow off is that formed by the capacity of the machine itself (as shown by the arrows). The maximum surge tension will then assume the value $I_1\sqrt{(l/c)}$.

Suppose now that we place the resistance R in shunt with the oil switch; the stored energy has then two paths through which it can flow off, viz., through the capacity of the machine against earth and through the resistance R. The winding of the machine with its uniformity distributed self-induction and capacity is equivalent to a line except that the values of these constants are different. Messrs. Ivan Dory,

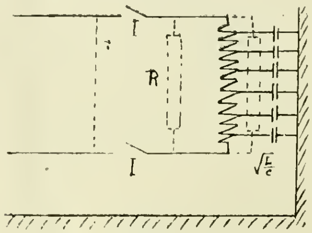


Fig. 6

Devaux-Charbonnel and others have shown by different and independent methods that a line of this nature is, as regards the propagation of electric waves equivalent to a simple ohmic resistance having the value of $\sqrt{(l/c)}$.

This is true in all cases where the value of $\sqrt{(l/c)}$ is appreciably greater than the ohmic resistance of the machine, i.e., whenever free oscillations are able to develop in the line, i.e., frequencies above 2,000 per second. In Fig. 6 the discharge capacity of the alternator is replaced by a shunt resistance and under these conditions the calculation becomes identical with that which we have made above in the case of high frequency current; the resistance of the two discharge paths will be

$$\frac{R\sqrt{(l/c)}}{R+\sqrt{(l/c)}}$$

If at the instant when the automatic switch breaks the short circuit, there be a current of I_1 flowing, then the maximum surge tension at the terminals of the alternator will be

$$\frac{I_1 R\sqrt{(l/c)}}{R+\sqrt{(l/c)}}$$

$I_1\sqrt{(l/c)}$ is again the maximum theoretical surge tension without limiting device and therefore the reduction factor introduced by the protective apparatus is again as above,—

$$\frac{R}{R+\sqrt{(l/c)}}$$

The same things happen on the other side of the automatic switch, that is to say, on the line side. Before the short circuit is broken the cable carries the short circuit current and a certain amount of energy is stored in the self induction of the cable; at the moment of break, this energy which can no longer flow off to the alternator, can only be stored in the capacity of the cable and oscillates to and fro between the self-induction and the capacity until absorbed by the ohmic resistance of the conductors.

The effect produced by a tension limiter placed across the ends of the line is identical with that which we have just calculated for the case of an alternator and the reduction factor for the surge tension is again

$$\frac{R}{R+\sqrt{(l/c)}}$$

the only difference is that in this formula l and c stand re-

spectively for the kilometric self-induction and the capacity of the cable.

Other phenomena may also occur in cable systems; there may be accidental resonances due to the harmonics of the machines and the capacity of the cables, but in this case the natural oscillation frequency is only 3, 5 or 7 times the normal frequency of the alternator. For these very low frequencies we may neglect the capacities of the alternators as against their self-induction and the self-induction of the cables as against their capacity and we have then a very simple case where a self-induction (that of the alternators)

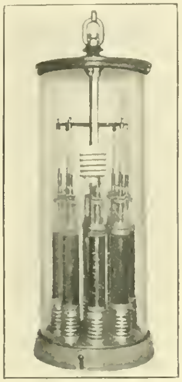


Fig. 7

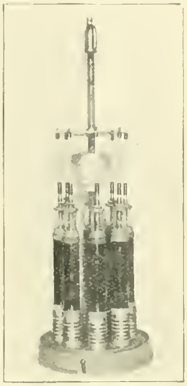


Fig. 8

enters into resonance with a simple capacity (that of the cables). At the point where both join, enormous surge tensions may arise. If this condition of resonance is temporary, we may deal with it by means of liberally calculated tension limiters, but if the resonance is permanent, i.e., if it is reproduced periodically, no tension limiter would be able to deal with the energy of the whole distribution system, without assuming ponderous dimensions.

Effect of the Operation of a Horn Arrester

As we have shown above, the horn arrester must be placed in series with a resistance and must fulfil two contions.

1. The resistance must be higher than $\sqrt{(l/c)}$ (the ratio being taken at its maximum value). Otherwise when the horn arrester breaks its arc it would produce higher voltages than those for which it is adjusted, and the arc would constantly re-form and keep the arrester permanently in operation.

2. This resistance must be greater than twice $\sqrt{(l/c)}$ since otherwise the conditions of non-resonance in the oscillatory circuit formed by the horn arrester, its resistance, the self-induction and capacity of the alternator would not be fulfilled and as a consequence high frequency resonance might be the result.

In practice, since the estimate of the value of $\sqrt{(l/c)}$ is not very exact, we have to take R greater than $4\sqrt{(l/c)}$, we have seen above that the surge tension is reduced to

$$\frac{R}{R+\sqrt{(l/c)}} = \frac{4\sqrt{(l/c)}}{\sqrt{(l/c)}+4\sqrt{(l/c)}} = \frac{4}{5} = .8$$

Therefore, a horn arrester calculated as carefully as possible, but having a certain minimum resistance, will produce a reduction of 20 per cent. in the surge tension, that being the most favourable case. We must therefore say that such an apparatus is useless because it is easy to prove that the maximum theoretical surge tension in the case of the breaking of a short circuit may rise to 150,000 or 160,000 volts whatever the voltage and output of the alternator.

The "Valve" or Tension Limiter

The limiter is built up of 6, 8 or 12 columns in parallel, each column being provided with an individual resistance of 800 to 2,500 ohms, according to the requirements of the case so that under certain conditions valves are supplied having a resistance as low as 70 ohms; if necessary a number of such valves can be placed in parallel. The first spark gap is made adjustable; the upper ball is fixed to the end of a screw with a 2 mm. pitch so that this gap may be accurately set, and in order to protect it against the deposition of dust or foreign matter this gap is enclosed in a small glass cylinder.

The other spark gaps are fixed and consist of suitably shaped flat discs, which have a considerable cooling surface so that the sparks always take place between cold electrodes and therefore are easily extinguished without special blowing arrangements. The small condensers are placed inside the columns and are not visible in the photograph, Fig. 7. Each column is connected to an upper paralleling disc through the medium of a high tension fuse, which would cut out any column in which, by some mischance, the insulation had been pierced. The whole of this valve is enclosed in a large glass cylinder, as a protection against dust and also to prevent any of the parts being touched.

This valve shows the following advantages.

1. It is possible to provide it with a total resistance as low as may be required for the effective discharge of low frequency surges, without introducing any danger from resonance troubles.

2. It assures the extinction of the sparks (caused by the surge tension) at every half period.

It is owing to this feature that it has been possible to wind the resistance with only a few grams of wire because the energy to be discharged represents only a fraction of a calorie and may be easily absorbed if we take care that the line current does not pass through for any appreciable time.

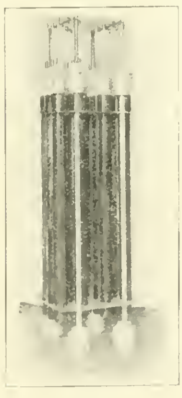


Fig. 9

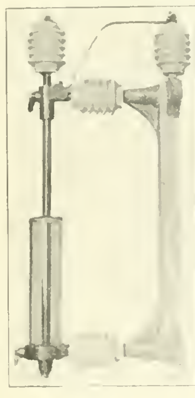


Fig. 10

With other appliances, such as the horn arrester, which take a few seconds or several hundreds of half periods before the arc breaks, the energy to be dealt with represents tens of calories so that we are obliged to put heavy and cumbrous resistances in series, which are, besides, quite useless for dealing with surge tensions, because their ohmic value has to be too high.

Fig. 7 represents the Giles Valve with glass cover installed; Fig. 8 the same with cover removed. Fig. 9 shows the Mosciki condenser, 18,000 volt type; Fig. 10 the slow-break condenser switch for 18,000 volt service.

Apparatus for Improving Power Factor

By Mr. Miles Walker, M.I.E.E.* (Con.)

Let us suppose that we wish to design a phase-advancer to be direct connected to an 800-h.p. induction motor driving a continuous current generator. If the motor has already been built, it is necessary to inquire whether its rotor is provided with a winding brought out to slip rings; and if so, whether the slip rings and brush gear are designed to carry the full-load current continuously. One could adapt a phase-advancer to almost any normal rotor winding (except, of course, a short-circuited winding) but if the current is very high and the voltage low, the cost of the advancer will be greater than where the current is fairly small and the voltage higher.

Suppose that the rotor has a 3-phase star-connected winding having a stand-still pressure of 800 volts per phase. The working current (that is to say, the current in phase with the voltage) will then be about 255 amperes, which can be collected on a comparatively small collector. To find the rotor current necessary to make the motor run at 0.95 leading power-factor, proceed as follows:—

Set off a vertical line representing 255 amperes, as shown in Fig. 8. The power-factor of an 800-h.p. 50-cycle motor running at 490 revs. per minute might be about 0.88, so that without the advancer one would have a lagging current equal to 47 per cent. of the working current. If the advancer caused the rotor to take a leading current of 47 per cent. (that is, 120 amperes) the power-factor at the stator terminals would be nearly unity. If now it is desired to make the power-factor at the stator terminals 0.95 leading, we must supply to the rotor an additional 31 per cent

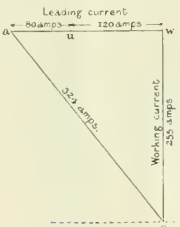


Fig. 8

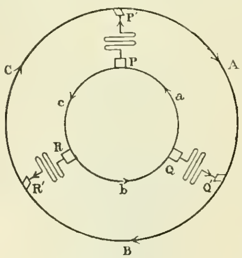


Fig. 9

of leading current, making 200 amperes wattless in all. Adding as vectors the 200 amperes wattless to the 255 amperes working current we get 324 amperes per phase for the rotor when running under these conditions. This is the current for which the advancer must be designed. If we had made the rotor with a voltage per phase of 400 we should have had 650 amperes, which would have made a somewhat more expensive, though perfectly possible, phase-advancer.

Next as to the voltage to be generated by the advancer. As the armature of the advancer is to be mesh connected, it is simpler to take the voltages across the slip rings than the voltage per phase of the star winding. Indeed, as the motor would work the same whether it were mesh connected, or star connected, we may, if we like, consider it mesh connected, as we have done in Fig. 9. If the normal slip of the motor at full load be 1.45 per cent., the e.m.f. generated by the slip will be 20 volts measured between rings. Lay off as in Fig. 10 the vertical line O Ea to represent this voltage generated by the slip in phase A. In Fig. 8 we have found the angle by which the current must lead on this voltage, so we can set off the line Oa to represent the current in phase A, Fig. 9. Similarly Ob and Oc represent the currents in the other phases. We should allow about 6 volts for pressure drop in brushes and in the resistance of the advancer. This will be represented by Ea R in phase with Oa. Then there will be some reactive drop in the field coils of the advancer. We may provisionally allow 5 volts for this, and after the machine is calculated we can make a check calculation to see if it is enough. This is represented by R X. There is no reactive drop in the armature because the compensating winding wipes out its field. We see that if we add a voltage X V, parallel to b a, we shall get a resultant voltage O V in phase with Oa; and this is what we want. If, therefore, we excite the advancer with a current which is in phase with the sum of Oa and—Ob (shown by the dotted line b a) we can make the current lead by the right amount. The voltage to be generated by the advancer is therefore given by X V, which when scaled off gives us 33 volts. It will be seen that the projection of O V on the vertical line gives us O Vr which is greater than O Ea. If this voltage O Vr is greater than is necessary to drive the working current through the rotor circuit, the only effect will be that the slip of the rotor will be reduced until we get the right working current for the load. If it should come out that O Vr is not sufficient to drive the working current, then the slip of the motor will be increased.

From Fig. 10 it appears that with 33 volts generated by the advancer the slip will be slightly reduced. We thus arrive at the rating of the advancer, namely, 33 volts between terminals and 324 amperes per phase.

We have next to decide what type of advancer to build. In this case it is not necessary to adjust the amount of leading current taken from the line at all loads, nor is it necessary to control at all loads the boosting effect of the advancer. It will therefore not be necessary to install a separately excited advancer. It will be found that the series-wound advancer will have more suitable characteristics for the case in hand than a shunt-wound advancer. With a series excitation the amount of leading current taken from the line increases with the load, so that the power-factor of the motor remains more nearly constant than where the excitation of the advancer remains constant. We will therefore decide upon a series winding. Next as to the type of armature. When the voltage to be generated is of the order of 30 volts or higher, and the current is reasonably low, as in this case, the best kind of armature is that with a closed winding just like an ordinary continuous current armature.

Theoretically, three salient poles (equivalent to two magnetic poles) are quite enough for a machine of the rating required in this case, but a machine of six poles (equivalent to four poles magnetically) is more likely to fit in with standard frames and standard punchings. We will therefore decide on six poles. This will give us six brush-arms, two in parallel in each phase. There will be 162 amperes per brush arm, and 162 ÷ 1.73 = 94 amperes per conductor.

As the speed of the main motor in this case is quite high, 490 revs. per minute, it is quite a good plan to couple the advancer directly to it, just as one would an exciter to a high-speed synchronous motor. We will consider later the arrangements which can be made for low-speed motors.

*Presented before the I.E.E.

We shall therefore take the speed of the advancer at 490 revs. per minute.

It will not be worth while to cut down a machine of this type to the smallest possible size, because the addition of a little superfluous material will not increase the cost by a very large percentage, and when we are making a machine we might as well make it so that without much further development it may be used in a large variety of cases. If we take a large $D^2 L$ constant of 9.5×10^5 cubic cm. it will not be excessive, though very ample. A diameter of 46 cm

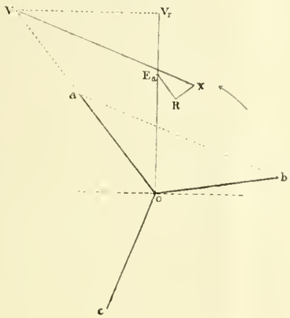


Fig. 10

is suitable for a speed of 49 revs. per minute, and the length of iron may be 18 cm.

The easiest way of designing a phase-advancer of this type is to proceed as if it were a continuous-current machine whose voltage is 1.41 times greater than the virtual voltage called for in the specification. The armature need not differ in any particular from a continuous-current armature. The field winding will be provided with series exciting coils and compensating windings connected to the various phases in the manner described above.

The main points to look to, that are not found in a continuous-current design, are:—

1. The machine though having six salient poles is a 4-pole machine magnetically, and we must remember this when fixing the dimensions of the iron behind the slots.
2. The voltage to be generated as a continuous-current machine is 1.41 times greater than the virtual voltage called for.
3. The fluxes in the salient poles which constitute magnetically a pole-pair are 120 deg. apart in phase, so that the voltage generated in an armature coil which lies partly under one pole and partly under another is only 0.86 of the voltage that would be generated if the two poles were carrying the maximum flux at the same time.
4. It is necessary to arrange the series winding on each pole so as to cause the flux to lead, by the right amount, ahead of the current carried by the armature conductors passing under the pole.
5. It is desirable to arrange the compensating winding so that its effect is equal and opposite to the armature winding adjacent to it, and for this purpose it is necessary to have regard to the phases of the currents in the armature and field.
6. It is desirable to provide a commutating flux which shall be proportional to, and in phase with, the current to be commutated.

We begin, then, just as we would on a continuous-current generator. The voltage to be generated is $33 \times 1.41 = 46.5$ volts. There are six ways through the armature, each carrying 94 amperes. If we choose 72 slots with 4 conductors per slot we get 288 conductors, and these multiplied by 94 give us 27,000 ampere-wires, a fairly easy current-rating for an armature 46 cm. in diameter.

If we denote the area of the cylindrical working face of the armature by Ag and the maximum flux density in the gap by B, then we may take the magnetic-loading as proportional to Ag B. If we have a pole arc equal to 0.72 of the pole pitch, then as there are 48 conductors in series and the speed is 8.2 revs. per second—

$$46.5 \times 10^8 = 0.72 \times 8.2 \times 48 \times Ag\,B \times 0.866$$

Observe the multiplier 0.866, which comes into the equation on account of the circumstance mentioned in paragraph 3. above.

Thus we arrive at the magnetic-loading $Ag\,B = 0.189 \times 10^8$. If we work the iron in the teeth at 18,500 lines per sq. cm., we shall require a total mean cross-section of all the teeth of 1,020 sq. cm. Our conductors, to carry normally 94 amperes and 25 per cent. overload, may be made 0.23 by 1.27 cm. Four of these will require slots about 0.77×3.7 cm. To provide room for 72 slots and give the necessary cross-section to the teeth we shall require a net length of iron of 16.4 cm. Allowing 11 per cent. for paper on the punchings and 0.6 cm. for a ventilating duct, we arrive at a gross length of iron of 19 cm. The rest of the calculation of the armature is the same as for a continuous-current machine, except in the matter of commutation, which we will consider later.

We must now consider how we are to wind the field poles so as to give to the excitation its proper phase. The first point to note is that the six armature circuits are connected in mesh, while the leads from the brush-holders are connected in star.

In Fig. 9 we have a diagram of connections as they would be if the machine had only three brushes. Obviously this diagram applies equally well to the machine with six brushes where brushes at opposite ends of a diameter are in parallel with one another. The inner circle of Fig. 9 represents the closed winding of the armature of the advancer. The small letters, a, b, c show the three phases mesh connected. Three brushes—P, Q, and R—bear on the commutator and convey the currents to the outer circle. A, B, C, which represents the winding of the rotor of the induction motor taken as mesh connected. It does not matter in practice whether the rotor of the induction motor is star or mesh connected, but for our diagram it is convenient to connect it in mesh. The arrowheads show the direction along each conductor which is taken as positive for the purpose of our clock-diagram, Fig. 10. P, Q, and R are in star, and it is only in series with them that we can connect the series exciting coils. The voltage in phase A of the rotor is the voltage we would measure by connecting a voltmeter to the collecting brushes P' and Q'. In order to make the current in this phase lead, it is necessary to generate a leading electro-motive force in the part a of the armature circuit. From Fig. 10 we found that a suitable e.m.f. to inject into phase A was the e.m.f. XV, which is in phase with (a—b). From Fig. 9 we see that the current in Q is (b—a), so that — Q is (a—b). We will therefore excite the poles under which coils a are passing with —Q. The span of the armature coils is almost a pole-pitch, so that the coils in phase a will be passing under two adjacent poles, which we will call pole P'' and Q''. Now it is not convenient to use only the conductor Q to excite P'' and Q'', because we have to arrange for return paths and also for a compensating winding, and we want to make a fairly simple mechanical arrangement of the coils. We therefore take advantage of the known fact that currents P + Q + R = O, therefore Q = — P — R. Let us make an arrangement of exciting windings and compensating windings like that indicated in Fig. 11 There are ex-

citing conductors which pass between poles P″ and Q″ are + Q, + Q, — P, —R. That is to say, they are equivalent to 3 Q. The question whether the excitation + Q gives a forward or a backward e.m.f. in a coil depends upon the direction of rotation, and also upon the question whether the armature is wound right-handedly or left-handedly. It will be seen that this arrangement of conductors lends itself to form mechanically a simple barrel winding. The conductors lie in two layers, and all the end connectors of one layer are bent to the right and all the end connectors of the other layer are bent to the left.

The letters in Fig. 11 which are placed on the salient poles represent the compensating windings. It is easy to prove that these are in direct opposition of phase to the currents in the armature under the pole. For instance, take the pole P″. The compensating winding on this is, + P + P — R — Q, or + 3 P. Now the armature coils which lie under P″ are c and — a, and we know that a — c = +

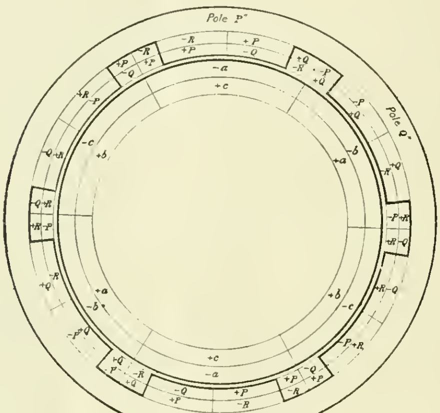


Fig. 11

P. Moreover, the 16 conductors in the pole face carrying the currents P, Q, and R are equivalent to 12 conductors carrying the P current. Opposite the pole P″ are 12 armature slots each carrying — 2 a and 2 c. When we remember that there are two paths in parallel per phase in the armature we see that the currents in these 12 slots are exactly balanced magnetically by the 12 P currents in the compensating winding.

It will be found that an air-gap of 3 mm. will have an apparent length of 3.6 mm. when we take into account the opening of the slots. The flux density in the gap obtained by dividing Ag B by Ag is 6,950; so that the ampere-turns on the gap will be 2,000. The ampere-turns on the armature teeth will be 510, and on the rest of the magnetic circuit about 190; so that the ampere-turns per pole will be about 2,700 or 5,400 per pair of poles. These ampere-turns are provided by the 16 conductors which thread between the poles P″ and Q″, for the 16 conductors carry current equivalent to 3 × 4 P. At its maximum P is 324 × 1.41 amperes, which multiplied by 12 gives us 5,500 ampere-turns per pair of poles. In practice it will be found unnecessary to adjust the speed exactly, because the particular power-factor at which the motor runs is not a matter of importance. It is not usually necessary to make any provision for the adjustment of the power-factor during running; it is sufficient that the motor shall take a leading current from the line at all loads. If it should be necessary to adjust the power-factor, this can be done either by changing the speed of the advancer or by diverting some of the field current from the series coils.

In cases where the speed of the motor is not great, it is more economical to belt the advancer to it so as to obtain a higher speed. In other cases the advancer may be run from any convenient countershaft in the mill where it is used, or it may be directly connected to an independent motor.

Commutation

The most important consideration of the design of the phase-advancer is the obtaining of good commutation. It is chiefly for this purpose that the field frame and winding described in this paper are provided. Where in a continuous-current generator the voltage between the bars is small, the commutation can generally be forced by the resistance of the carbon brushes; but it is very much more desirable to provide a commutating e.m.f. which shall at all times be proportional to the current to be commutated. In the machine here described this result has been effected by giving each armature coil a span of somewhat less than the full pitch and arranging the positions of the brushes so that one of the limbs of each coil is moving in the fringing field of a pole excited by a current which is at all times proportional to the current under commutation. The currents in the two branches of the armature, a and — c, which combine to form P, are out of phase with one another and are not directly under control of the commutating flux; but the rate of change of the current in the coil under commutation ought at all times to be proportional to P. Now the pole P″ (Fig. 11) is excited so that the fringing field in which the left-hand limb of the coil a is moving is at all times proportional to P. By making the coil with a short throw the right-hand limb can be taken out of the influence of the pole Q″. The exact position for the brushes is, of course, obtained by trial; in practice it is found that the commutation is perfect. The alternation of the current in the armature and field causes a harmful e.m.f. to be set up in each coil under commutation; but as the frequency is so very low (say one cycle per second), this e.m.f. is not sufficiently great to create any disturbance. In the machine under consideration it only amounts to one-sixth of a volt.

Performance

In a certain mill in the north of England there is a 250-kw. generator which on account of the low power-factor of the motors connected to it is somewhat overloaded. As it would be a rather costly undertaking to install a new generator, the alternative proposition was put forward of connecting a phase-advancer in circuit with the rotor of a certain 140-h.p. motor in the mill. It was seen that this at least would help matters, although the capacity of the motor and its phase-advancer were not great enough to bring the power-factor up to unity. A 5-kv.a. advancer was installed, with the result shown by the following figures:—

Total Load on Mill

	Amperes per Phase.	Volts.	Power-factor
Advancer cut out	325	440	0.70 lagging
Advancer connected in ..	240	440	0.92 lagging

Motor Load Only

Advancer out	105	440	0.74 lagging
Advancer in.	97	440	0.96 leading

Whenever the advancer was switched in the volts of the generator rose from 440 to 470. The figures in the above table were taken after the rheostat had been adjusted to make the voltage normal.

ELECTRIC RAILWAYS

We illustrate herewith one of the street cars recently placed in operation on the municipal lines in East Toronto. This line is approximately two miles in length and four cars are operated. The rolling stock also includes a sweeper. The cars were built by the McGuire-Cummings Manufacturing Company, of Chicago. The seating capacity is 40, made up of transverse seats to accommodate 24 people, and lengthwise seats at the corners to accommodate 16, 8 in each end 4 to a side.

The general specifications of the Toronto cars are as follows: Length over buffers 44 ft.; length over car body corner spots 30 ft.; extreme height over running board 12 ft; width between posts 7 ft. 9 ins.; width over sheathing 8 ft. 4 ins.; width over all 8 ft. 9 ins.; length of platform over vestibule 6 ft. 6 ins.; length of platform over buffer beam 7 ft.; centre to centre of trucks 19 ft.

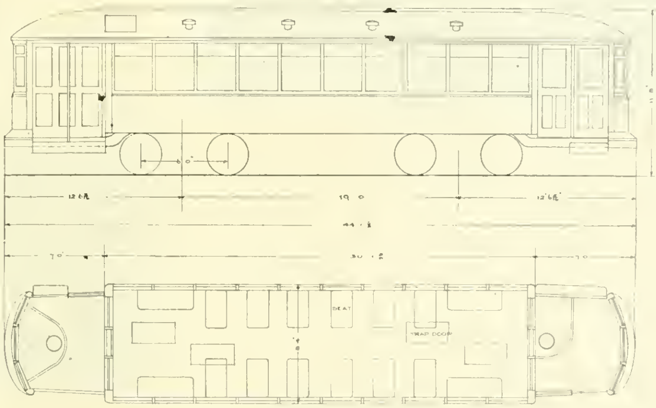
The side construction is built of 19½ by 5-16 in. side girder plate with a 3 by 3½ by ⅜ in. angle riveted to the bottom with a 2½ by 5-16 in. angle on the top. End sills are 9 in. by 15¼ in. channel riveted to the side girder plate. To the inside of the side girder plate there is a 7 in. by 14¾ in. platform knee channel reinforced on the inside with 6 in. by 1½ in. plate. The bolsters are two 7 in. by 14¾ in channel irons with plate riveted on the top and bottom. Through the centre of the car is a T iron of suitable size to support the trap doors. The car is braced diagonally under the platform with a 4 by ⅝ in. plate and at centre of car with 2½ by 2½ by ¼ in. angles and at three intermediate points across the car are located 6 in. by 8 in. channel iron. The buffer beam is a 7 by 3½ by 7-16 in. angle connected to the longitudinal platform knees with suitable connections. The floor beams are filled with oak or yellow pine nailing strips. The upper frame consists of posts all of ash. The intermediate posts are 1¾ by 3½ in. The corner posts are built up to 5⅜ inches in thickness and width to suit. The side posts are tenoned into the sill and plate and are tied together with ½ in. strap bolts with the exception of the corner posts which are ⅝ in. rods. The side plates are all long leaf yellow pine 2 inches in thickness. The vestibule posts are in one piece. The side posts are arranged so that the upper sash will be stationary with the lower sash dropping into the partition.

The roof framing consists of four double ash car lines with a 1½ by ⅜ in. steel car line sandwiched between. Beneath these iron car lines are five ⅞ in. ash car lines cut to contour of roof.

The car flooring is 13-16 by 3¼ in. yellow pine. The floor is double with building felt paper between. In the aisles is a 13-16 by ⅞ in. maple matting screwed to the floor with brass screws. The vestibule floor is 1⅛ in. by 3¼ in. tongued and grooved oak substantially nailed to floor nailing strip and laid crosswise of the floor, the end board being substantially framed into the oak-nose piece.

The side sheathing is 9-16 in. tongued and grooved poplar securely nailed and glued to a ¾ in. continuous blocking. The vestibule is sheathed with No. 14 B.W.G. steel. The roof is of the turtle back type ½ in. tongued and grooved poplar, painted inside and out, covered with heavy cotton duck to which has been applied three coats of lead and oil. The vestibule hoods are framed on ash car lines and have two thicknesses of ¼ in. poplar roofing covered with cotton duck. On the top of the roof there are three 1½ by 6 in. long leaf yellow pine running boards securely fastened to the roof with screws so as to prevent roof from leaking.

The vestibule is of the p.a.y.e. type though this method of collecting fares has not yet been installed. They are equipped with interchangeable railing of one inch iron pipe. The entrance doors are of triple type and equipped with Buner sliding folding door fixtures and arranged with ¾ in. pipe lockbar across the inside of the door. The exit door is operated by a lever mechanism. The inside of the vestibule is in natural wood finish. The sash in the door pocket inside the vestibule is arranged to swing open so as to give access to the door mechanism. All end windows in the vestibules are arranged to drop.



Sectional diagram Toronto's municipal cars

The interior finish of the car is quarter sawed oak. The wainscotting from top of truss plank over heater pipes to the arm rail is in narrow tongued and grooved well-matched material 9-16 in. thick. The car is equipped with bottom sash arranged, to drop and with a flap covering the pockets All doors are glazed with ¼ in. plate glass. The side windows are equipped with pantesote covered curtains hung on Hartshorn rollers and friction fixtures. Doors and windows directly in rear of the motorman are equipped with a curtain so as to exclude light. The side windows are equipped with diagonal mesh guard wire covering each window for a height of approximately 12 ins. These are fastened at the corners with bevelled thumb screws so as to be easily removed or arranged so they will not rattle.

The exit rear door is arranged to slide into a pocket and has malleable iron threshold plate. The entrance door is of the double swing type with step on inside of car so as to prevent door from swinging in. The seats are rattan reversible type with 20 in. backs, grab handles and 36 in seats. The corner seats are stationary, 56 ins. in length and are boxed in solid under the seats with a cast grating in front to let heat out.

The car is equipped with a hot water Cooper heater with

three lines of $1\frac{1}{2}$in. pipe down each side of the car and three coils of heat in the front vestibule. The vestibule heater pipes are covered with grilling to prevent injury to the passengers. The heater is set inside the body of the car as shown in the drawing. The vertical type in the vestibule is covered with a layer of $\frac{1}{4}$ in. asbestos and painted.

Other equipment includes sand boxes, foot gongs, trolley

Interior Toronto's municipal cars

catchers (Knutson type), draw bars, head lights (Crouse-Hinds incandescent head light, type Z, one on each end of each car), push buttons at each post; conductor signal bells, etc. The cars are equipped each with one set of G.E. 80 four motor equipment for double end operation. Each car is also equipped with standard G.E. air brake equipment for double end operation supplemented by hand brakes, fenders of the sliding type, manufactured by the McGuire-Cummings Manufacturing Company, are installed.

The steps are arranged to fold up when not in use. The

Exterior cars operated by City of Toronto

steps on each side of the car being mutually operated by means of a wrought iron connecting bar. These steps are lighted by five incandescents placed immediately above the passenger's head as he alights and which are automatically switched off and on by the movement of the door.

The trucks are McGuire-Cummings manufacture M.C.B. No. 10A type. The wheel base is 6 ft. 10 ins.; length of frame 9 ft. 8 ins.; top of truck bolster to rail $26\frac{1}{2}$ ins. The bolster springs are the double elliptic type 28 ins. in length; equalizer springs $1\frac{1}{4}$ ins. by 7 ins. high, manufactured by the Crucible process. Wheels are cast iron, 33 ins. in diameter. Axles were made by the open-hearth process. All castings were made of tough gray iron. The journal boxes are of cast iron. The spring seats for coil springs resting on the equalizing bars are cast iron. Journal bearings are bronze for $4\frac{1}{4}$ by 8 in. journal, lined with $\frac{1}{4}$ in. babbit. The sweeper is also equipped with G.E. 80 40 h.p. motors for both motive powers and for operating the brooms.

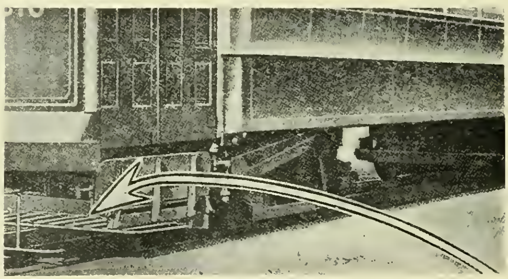
Car barn 96 ft. by 27 ft. 2 ins. has been built to accommodate these cars though it is understood this building is temporary. A five to seven minute service is being given and the cars will be operated on Sunday as soon as permission has been obtained from the legislature.

Power is obtained from the Toronto hydro-electric system through the use of a motor-generator set.

The work of construction of these lines and their subsequent operation have been under the immediate charge of Mr. C. W. Power, assistant engineer of Railways and Bridges for the city.

The Wheel-Guard Most Effective

The Parmenter Fender and Wheel Guard Company have just completed arrangements whereby their products will be manufactured in Toronto, Canada, and it is the intention of this firm to push their business actively in the Canadian



Wheel guard is suspended to truck frame

field. The Parmenter wheel guard has shown its effectiveness in saving lives in a number of instances where other types of equipment would doubtless have resulted in fatalities. By attaching the wheel guard to the truck frame it follows both rails even when rounding a curve, thus giving protection where it is most needed. This method of attachment also eliminates the possibility of the guard getting broken up by striking obstructions, thus proving the advantages of truck suspended wheel guards over a body suspended guard. The accompanying illustration shows the guard under ordinary car operating conditions.

Railway Statistics for 1912

The Railway Statistics of the Dominion of Canada for the year ending June 30, 1912, is just to hand. Under the electric railway section fifty-four different roads are treated. The total length of single track is placed at 1,723.5 miles. The total outstanding stock issued against these roads is $70,829,118, the total bond issue $51,389,223, a total of $122,-841,946. The total gross earnings from operation is given as $23,499,250: the operating expenses at $14,266,674, leaving net earnings from operation of $9,232,575. These figures show average operating expenses as 60.7 per cent. of gross earnings throughout the Dominion. The total number of

passengers carried during the past year was 614,319,502. The total number of passenger cars in service is 2,049 closed, 866 open and 574 combination, closed and open, making a total of 3,489. Total number of freight cars operated 483, mail, express and baggage cars 33, combination cars 7, work cars 103, snow ploughs 57, sweepers 112, miscellaneous 194, bringing the total number of cars operated in Canada to 3,478. The number of passengers killed during the twelve months was 16, employees 8, others 86, total 110.

The mileage figures are evidently well within the mark at the present moment, as much extension work has been carried on since these records must have been collected. Also a number of the more recent roads have not been included, such as Lethbridge, which at the present operates about 11 miles, Regina operating 15 miles and the Niagara, Welland & Lake Erie operating 3 miles. The prospects for additions to the mileage during 1913 are very bright. At the present time the Toronto Eastern has some 25 miles practically ready for operation, with another 20 to follow early in the spring. The Toronto Suburban will probably reach Guelph during the summer. The N. S. & T. will also be operating many more miles of line. These are only examples of the way a very large number of our electric roads are expanding at the present time.

A New Rail Bond

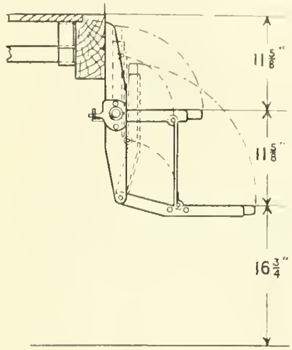
An entirely new method of making contact is used in a bond just placed on the market by the Ohio Brass Company, and known as their Type J All-Wire Rail Bond. Reference to the illustrations will show the novel features of construction. A pin is formed in the centre of an annular hole milled in the rail by a hollow cutter. This pin fits into a hole drilled in the bond terminal and, being an integral part of the rail, makes current carrying contact on the inside of the terminal in addition to that secured on the outside as in the ordinary bond. This bond is installed on the ball of the rail by driving the terminal home with a hammer. This operation compresses the copper and causes it to grip both the outer surface of the hole and the central pin. Electrically, the contact surfaces C, D and E are more than required for the capacity of the bond. The contact surface C on the pin B is absolutely protected against moisture and other corrosive elements, being far removed from the outer surface of the rail.

A special hollow milling cutter is provided for milling the annular hole in the rail. It is made of high speed steel and facilities are provided for quickly and accurately regrinding it in the field. A motor driven milling machine has been developed for use in the installation of this bond. It mills two holes simultaneously, feeding the cutters automatically. When the holes are finished, the cutters are backed out, many times as fast as they are fed in, without stopping or reversing the motor. The machine can be quickly clamped to the rail or released and is mounted on wheels for moving along the track. Two men can easily lift it from the track to allow cars to pass. The motor is especially designed for this service and operates on a 550 volt d.c. circuit with a maximum current consumption of approximately 2 amperes. The controlling switch is located on top of the machine within easy reach of the operator. Two men can mill the holes while a third cleans the holes, installs the bonds, removes crossing planks, etc.

An electric railway company who recently installed several thousands of these bonds report that under ordinary conditions three men can install from 125 to 150 bonds per ten hour day. This bond at present is made only in 4/0 capacity and is designed for use on 60 pound and heavier rails. It is an all-wire construction, the terminals being formed of the same strands that compose the body.

A Neat Double Folding Step

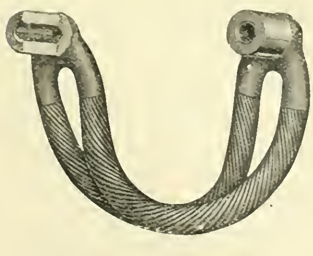
The accompanying illustration represents a type of double folding steps being used on the cars of the Muskogee Electric Traction Company. The car floors are high and the entrance and exit doors are pivoted and work in unison



with these double folding steps which were rendered necessary in order to get as low a step elevation as possible. The rear entrance and exit doors and steps may be operated separately or together, and are manually controlled by the conductor through a simple system of levers.

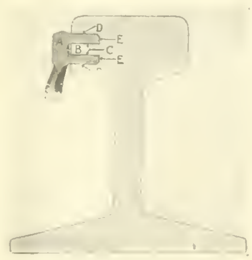
New Cars for Calgary

An order for twenty-four double truck p.a.y.e. cars has recently been placed with the Ottawa Car Company for the Calgary Municipal Street Railway. Twelve of these cars will measure 46 feet in length and twelve 41 feet. The former will have a seating capacity of 46 and the latter 42. They will be of the semi-convertible type with 18-in. x 3/8-



The new O-B bond

The annular hole in ball of rail



The bond installed

in. steel plates in side sills. The platforms are to be reinforced with 6-in. by 3½-in. steel angles. The outside sheeting and interior finish, including all window sashes and doors are to be of cherry material finished in natural wood. The roofs will be of the Moncton type with bull nose ends. The seats are standard non-reversible type, spring upholstered and covered with rattan. The heating equipment will be the Peter Smith coal fuel, hot air and ventilating system, with the heaters located in the front vestibules. The window curtains are of pantasote material with Forsythe fixtures. All trimmings, such as door handles, will be of solid bronze with bright finish. The trucks are Brill No. 27-G-1 4 ft. 6 in. wheel base with Schoen rolled steel wheels. The motor equipments are Westinghouse No. 101-B-2, four motors per car, with K-6 controllers. The air brakes are also Westinghouse type. The fenders are Providence style C. The headlights are Crouse-Hinds, type Z, with Griel frame doors. All the other appliances and equipment will be of the very latest and the arrangements will be planned so that the greatest amount of comfort can be given to the passengers. These cars will be ready for delivery early in April. The Ottawa Car Company have also received an order for six trailers from the same corporation. These will be delivered about the end of March.

St. Clair Electrification

The train service operated by the Grand Trunk Railway system through the St. Clair tunnel which connects Sarnia and Port Huron under the St. Clair river is claimed to be the heaviest railway service handled by electricity in the world. This electrification operates within a zone of approximately four miles, the motive power being derived from 1,500 h.p. electric locomotives, each weighing 135 tons with a normal draw-bar pull of 50,000 lbs. and a maximum speed of 35 miles per hour. The time taken to change engines is from two to five minutes, and the time of passing through the tunnel which, with its approaches is more than two miles in length, is 13 minutes. Up to 45 cars per train are hauled through the tunnel which represents a train more than one-half mile in length.

During the twelve months of 1912 the company's records show that 197,801 loaded freight cars and 86,692 empties passed through the tunnel, in addition to 35,096 passenger cars. Estimated on a basis of 17 tons per car, this gives a total tonnage passing through the tunnel of approximately 3,500,000. These figures do not include any company material such as coal, lumber, ties, etc., which would swell the total to much larger proportions.

N.W. & L.E. Railway

At a recent meeting of the Niagara, Welland and Lake Erie Railway Company, Mr. T. R. Cummings was engaged as engineer, and plans were decided on to carry out the construction of the whole line during the coming summer. There will be about thirty-six miles of track running from Niagara Falls to Welland and Port Colborne, and then east along the lake shore to Fort Erie.

The extensions in the town of Welland on North Main street to Parkway Heights, on East Main street to Rosedale, and south into Crowland, will also be built during the summer. Material is now on hand for these extensions and construction will commence as soon as the weather will allow. It is probable that that portion of the suburban line from Welland to Dain City and Port Colborne will be built first, but it is hoped the whole line will be in operation this year. It is understood that the new engineer has already taken up his duties and is preparing for a start on a final survey of the line.

Mr. Jeffrey is Manager

Mr. W. K. Jeffrey, who has been acting manager of the Ottawa Car Company since the death of Mr. James Buchan, was appointed manager on February 1st. Eight years ago Mr. Jeffrey joined the Ottawa Car Company as apprentice to the car building trade. He was then twenty-four years of age, and by sheer perseverance and ability has risen to his present position. For about two years and a half he was in the car shops. Then he went into the draughting office and after about a year and a half there, was promoted to the position of acting manager. Mr. Jeffrey is a native of Kinburn, Ont. Prior to coming to Ottawa he engaged in building and contracting in his home village.

Miscellaneous

The representatives of a number of municipalities who met in Toronto towards the end of January to discuss the possibility of a municipally owned and operated electric railway system connecting Toronto with a number of towns to the north as far as Port Perry and Uxbridge, have approached the Dominion government for a subsidy of $6,500 per mile. The idea of building the line was enthusiastically supported by Toronto and the other municipalities represented.

The street car system of Fort William and Port Arthur will have a deficit for the year 1912 of approximately $7,500. This is according to a report recently submitted by Mr. M. C. Wilson, secretary-treasurer of the Port Arthur and Fort William electric railway system. In future the night fare of 10 cents will be collected after 11 o'clock on this system.

The Toronto and York Radial Railway Company have made application to the Ontario government for power to enter into an agreement with the city of Toronto for the double tracking of Yonge street from the C.P.R. tracks to York Mills, terms to be settled by the Ontario Railway and Municipal Board.

The city council of Hamilton and the street railway company have reached an agreement providing for the extension of the street railway system in the north-eastern and south-eastern parts of the city of Hamilton. It is estimated by the company that the expenditure will be approximately $500,000.

Owing to certain delays in obtaining the signatures of the interested parties to the street railway agreement, it is not expected that the by-law with reference to the street railway franchise can be submitted to the citizens of Medicine Hat before the middle of March or the 1st of April.

Encouraging reports of increased revenue come from Nelson, B.C. For the week ending January 7th, 1913, the receipts were $223.35, as against $142.40 a year ago, and for the week ending January 14th, the receipts were $159.30, as against $127.95 for the corresponding week in 1912.

Mr. J. E. Hutcheson, manager of the Montreal Tramways Company, and formerly superintendent of the Ottawa Electric Railway has been made an honorary Lieutenant-Colonel. For several years he was an officer in the 43rd D.C.O.R., and resigned as major of that regiment.

Mr. F. D. Burpee, superintendent of the Ottawa Electric Railway recently gave a talk before the Ottawa Business Science Club, on "The Organization of a Street Railway."

Illumination

Matching Colors By Artificial Light

By Mr. H. L. Sheen

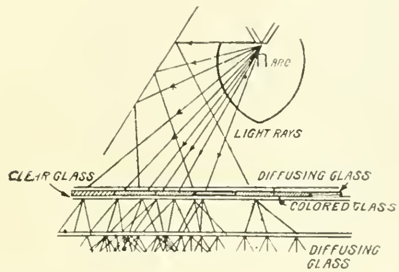
It is only quite recently that Illuminating Engineers have given their attention to the improvement of the color values of artificial light, the study of this important subject having been previously crowded out by quantity, efficiency, and distribution of illumination from the light giving source. At first the only consideration was quantity of light. This was followed by the consideration of efficiency and distribution, and lastly we have come to the consideration of color of artificial light. Colors matched in daylight with a standard will vary greatly with the condition of the sky; viz., sunlight, clouded sky, or clear northern sky. For accurate color matching the most constant natural standard we can utilize is light from a clear northern sky. On many days of the year such a light is not available, and even when the sky is clear, a working light is only given for perhaps six or eight hours of the working day. There has thus arisen a demand for a color matching light produced by artificial means, and

A "Correct Color" Lamp

after many years of careful experiment a lamp producing such a light has been put on the market in Canada by the Canadian General Electric Company.

Such a lamp cannot be expected to have a high efficiency, nor is this of great importance, as the light is not needed for the illumination of large areas. Its greatest value at present is to provide a suitable illumination, both as to intensity and quality, over a comparatively small area, where fine and accurate color work can be done. Such a lamp has an advantage over daylight in that its color and intensity remain constant while daylight varies with the weather and time of day, a matter of a few minutes frequently making a very great difference in the apparent color value.

This color matching outfit is a modification of the standard store lighting Intensified Arc Lamp which gives a diffused white light showing colored goods very closely approaching their average daylight values. A careful examination of the spectrum of this light reveals the fact that the red and orange are slightly in excess, while the well known "carbon lines" in the violet considerably accentuate that portion of the spectrum. In other words, to bring the light to standard daylight it is necessary to reduce the amount of



Sketch showing construction of Correct Color Lamp

red, orange, and violet without appreciably weakening the color in the middle of the spectrum.

A combination of several colors of glass has been obtained to give the desired light, and in order to avoid large absorption these colored glasses are placed side by side in small strips, and the emitted light is thoroughly mixed by passing through a pair of diffusing glasses placed a few inches apart, see diagram herewith. A hood with a reflecting surface surrounds the inner globe so that the light from the arc is transmitted and reflected down through the color screen, while at the same time the direct rays are kept from the eyes of the user. Two upper converging carbons and one lower carbon are employed, and the lamp proper gives a perfectly steady light of constant color value.

The practical uses of such a light are many, and this lamp should be indispensable in such places as department stores; textile mills; carpet factories; dye works; printing ink factories; lithographers; manufacturers of dye stuffs; paint factories; tobacco industries; leather industries; dental work for matching teeth, etc.

Take for instance ribbon counters and silk goods counters, and other places in department stores; it is found that the close color matching of goods is very difficult under the best of ordinary lighting conditions, and frequently impossible owing to insufficient and poor quality of light. In such places a few color matching outfits should be installed in convenient locations, where prospective customers can at any time take goods to be matched against samples, with the assurance of obtaining material of the color they actually require.

Illumination Data

A chart containing a lot of interesting information with respect to the proper placing of light units and the proper reflectors to use under different conditions has been recently prepared by the Holophane Company. The chart begins by defining the unit of intensity of illumination, that is, the "foot-candle" as the amount of illumination produced on any surface by placing a source of light of one candle-power, one foot away from this surface. The number of foot-candles required under different conditions is given in a table as shown below. It is not intended that these figures should represent any hard and fast rule, as decorations and other conditions must of necessity regulate the amount of light that is required under any given condition but they answer well in the average installation and can be followed with good results by any electrical contractor. The figures given follow:—

Desk	4	Show windows	
Draughting-room	8	Light colored goods	18
Factory, general	2-3	Medium colored goods	16
On work	4	Dark colored goods	20
Hospitals		Stores	
Wards	0.5	Art	4
Operating table	12	Book	3.5
Homes and hotels		Cigar	3
Reception-room	1.5	Clothing	5-7
Parlor	1.5	Confectionery	3
Library	2-3	Drug	3
Dining-room	2-3	Dry goods	4-5
Bedchambers	1.5-2	Furniture	5
Lobby	2-3	Furs	5-7
Auditoriums	2	Florist	3
Auto show-rooms	5	Grocery	3-4
Auto garage	2	Hardware	4-6
Ballroom	2	Hat store	4
Bank, general	2	Haberdasher	3.5
Billiard table	5	Jewelry	3.5
Cafe	2.5	Millinery	4
Church	2	Shoe	3-5

The number of foot-candles required in any installation will, of course, now depend on the number of square feet to be illuminated multiplied by the constant given in the above table. For example, take a hat store, size 40 ft. by 25 ft.; this will require 40 by 25 by 4, equals 1,000 foot-candles. The actual number of watts required will now depend further on

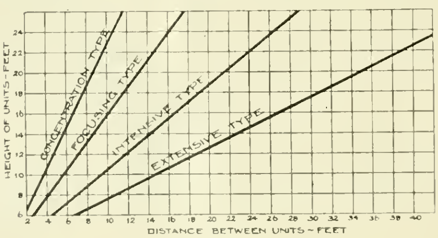


Fig. 1.

the condition of the ceiling and walls, and the chart contains the following data with reference to these varying conditions.

Lamps	Holophane reflectors	Ceiling	Walls	Constant
Mazda or Tungsten	Clear	Light	Light	5.0
Mazda or Tungsten	Clear	Light	Dark	4.0
Mazda or Tungsten	Clear	Dark	Dark	3.4

The meaning of this table is that if the ceiling and walls are both light the number of foot-candles in the above, that is 4,000, is divided by the constant 5, giving 800 watts required. If the ceiling is light and the walls dark, the 4,000 foot-candles are divided by 4, giving 1,000 watts required. If both ceiling and walls are dark, the constant is 3.4 and the 4,000 would have to be divided by this number to give the number of watts of energy required to illuminate the hat store under these conditions.

The next item to be considered in such an installation is the proper reflector to use. This company specify four reflectors for this type of work, viz.: the concentrator, the focusing type, the intensive type and the extensive type. These are illustrated herewith. To make a choice as to which of these four reflectors to use the procedure is as follows: Suppose the calculations already made have resulted in showing that 800 watts of energy is required for this particular room. This may be supplied in a variety of ways, for example, by two-400 watt lamps, four-200 watt lamps, eight-100 watt lamps, etc. The particular lamp to be used will be regulated by the outlets, fixtures, decorative conditions, preference of the customer, etc. The number of lamps having been settled, also their distance apart and their height from the floor, use is now made of the curves shown in Fig. 1. In this figure the horizontal numbers represent distances between outlets in feet; vertical numbers represent the height of the reflector. Suppose for example in this particular installation that the units are to be spaced 12 feet apart and 14 feet high. From the number 12 on the horizontal line follow the perpendicular upward until you touch the cross line representing the height above the floor

Concentrating Focusing Intensive Extensive

Fig. 2.

at which you have decided the lamp shall hang, 14 feet This will always bring you between two consecutive lines of the four shown in this chart and the one to the left of this intersection point indicates the type of reflector you must use to get the best results. In this case the line to the left is marked the "focusing" type. This indicates that the type of reflector shown above as the focusing type of reflector will give the best illumination results under our supposed conditions.

Handsome Scientific Books

D. T. McAinsh & Company, publishers, 123 Bay street, Toronto, are clearing out a number of handsomely bound scientific books which cover many interesting phases of modern electric practice. In the lists are included "A Dictionary of Electrical Engineering," edited by H. M. Hobart, M.I.C.E., M.I.E.E., M.A.I.E.E., in two volumes, imperial 8 vo., Roxburgh binding; "Science in Modern Life," edited by J. R. Ainsworth Davis, M.A., F.C.P., in six super-royal octavo volumes; "Modern Electric Practice," edited by Magnus Maclean, M.A., D.Sc., in six super-royal octavo volumes; "Technological and Scientific Dictionary," edited by G. F. Goodchild, M.A., B.Sc., and C. F. Tweney, one volume, super-royal octavo Roxburgh binding; "Modern Power Generators," edited by J. W. French, B.Sc., two volumes, super-royal quarto, cloth binding; "Machine Tools," edited by J. W. French, B.Sc., two columes, super-royal quarto, cloth binding.

Mr. E. H. Fitzhugh has resigned the presidency of the Montreal and Southern Counties Railway Company, and is succeeded by Mr. William Wainwright. Mr. W. B. Powell will continue to act as vice-president and general manager

The Dealer and Contractor

The Mutual Relations of the Electrical Jobber, Dealer and Contractor

By Mr. F. N. Averill*

Some contractors and dealers and some jobbers are quite likely not to agree with me in many of the statements which I may make here, and to them I wish to say that this paper is not intended to be an expression of other than my personal ideas. Some of these ideas are not practical to-day, but I sincerely trust that the time is near when they can be put into operation, by the firm which I represent, at least. Any criticisms offered are not intended as personal criticisms, but are criticisms of jobbers and contractors as a body.

Before I can get to the subject of the relations between jobbers and contractors it appears necessary, to my mind, to define what I think a jobber should be and what I think a contractor should be. It is quite generally granted that the jobber is the economic outlet for the manufacturer in marketing his products, as he acts in every trade centre either as a distributing agent or a direct representative of not only one manufacturer, but of many, and as a result can market their goods from one place of business with one sales organization at considerably less expense than the various manufacturers if they tried to market their goods direct, or if several of them should combine and work under one management. Further than this, the manufacturer has his accounts receivable in a comparatively few number of book accounts, and these few accounts are practically all safe ones. This explanation is one big reason why practically all manufacturers recognize and protect the jobber.

From the contractor's standpoint, one reason for the existence of the jobber is that the jobber gathers from the four corners of the country into one place of business the various lines of supply items used by the contractor in his work, and thus enables the contractor to secure from one source of supply practically everything he needs for the carrying on of his business. This stock enables the contractor many times to economize in his work, as he can go to the jobber's place of business and perhaps see what is to him a new line of fittings suitable for a certain piece of work, which line of fittings, perhaps, are much better adapted, cause a saving of labor and possibly are a cheaper line than the contractor originally had intended to use. Besides, the jobber can often suggest a certain line of material for a certain piece of work, due to his broader experience with the different lines on the market, where, if the contractor had to depend on purchasing from the manufacturer, he would not have the chance of changing his requirements. Very often a local jobber can and should be willing, and generally is, to post the contractor on any line of new stuff that is coming on the market, stands between the contractor and the manufacturer as to the quality of the goods, guarantees to the contractor that such items as he selects for a certain piece of work will be approved by his inspectors, or in case the article furnished is not suitable for the purpose and the inspectors turn it down, your local jobber is always ready to stand back of you and see that you get the right article for the work. In some instances, especially for slow moving merchandise, you pay the jobber more money than you would if you shipped your requirements direct, but in the majority of instances you pay the jobber considerably less money than if you pick up your hundred and one requirements from as many different sources of supply, and in the aggregate your costs are less.

On top of this, the jobber stands ready to assist you by enlarging your line of credit to a certain extent when you get up against delayed contracts, and when you lay before him in a straightforward manner the conditions which necessitate your asking for this extension of credit. This feature of the business is greatly abused by both sides; that is, the jobber and the contractor are both to blame. The jobber is to blame in that he is not strict enough with you, due to the fact that he is afraid if he is not lenient that he will lose your business and some one of his competitors will get it. Some of you take advantage of this fact and will make it a point to pay all other creditors, perhaps take a summer vacation, and allow your jobber, because he is a good fellow, to wait. This condition of affairs, instead of breeding confidence, breeds distrust and generally works out like loaning money to a friend, as after the money is loaned, you have lost your friend.

Jobber Should Not Compete

The jobber has recognized the fact that the manufacturer needed him as an outlet for his product, has also recognized the fact that the contractor needed him, and as a result we not only have one or two jobbers in every trade centre for this purpose, but in some cases we have nearly as many jobbers as there are contractors. As a result of the conditions which brought about the establishment of the jobber, I personally believe he is not entitled to, nor can he afford to take away the legitimate earnings of the contractor and dealer by entering into any lines of electrical business other than a purely jobbing or wholesale business and that these conditions do not make it right that he compete, directly or indirectly, with the contractor and dealer, either in the contracting or retail business. I have more respect for the jobber who comes out in the open, saying that he is operating a retail store and who retails his goods at retail prices and makes no bones of being a competitor of yours than I have for the jobber who side-steps the retail issue but who is, under cover, selling his goods retail at wholesale prices. The day has passed not so very long ago when jobbers made a practice of operating a contracting business along with their legitimate line and I feel that the time is passing when a jobber should operate any branch of his business to compete with the customers who make his existence possible. The opinion is quite agreed that the jobber is entitled to look for his outlet to the contractor and dealer, to the central station, isolated plant, municipal, State and National government, railroad, telegraph and telephone

*Read at Portland Convention of Electrical Contractors Association.

systems and the large industrial corporations, as it is quite apparent to anyone in the business that the demands of these buyers are such that no one other than a jobber can handle them in a successful manner as to service.

In carrying out my ideas of a jobber, he could as well be located in a warehouse or suburban location as in the heart of the city, as he would have nothing whatever to show the public, no show window displays, retail department or loafing rooms. At this time it would take a firm of strong courage and a well filled purse to put into effect all the ideas which I believe constitute a true jobber, unless all jobbers would get a change of mind at the same time.

As to the contractor and dealer, I believe the time is fast coming when the retail business will be taken care of by an electrical dealer operating a neat, well appointed store on some principal retail street, in which he makes suitable displays and demonstrations of the varied lines of electrical supply items and such electrical apparatus as appeals to the shopping trade. He will do practically no contracting, but will confine himself strictly to the retailing of such items as he carries and will do only such installation work as forms a part of his sales, together with a small repair department for minor work that would come to him. He will leave the competitive bidding, the new work and the troubles of the general contracting business strictly to the electrical contractor, who will conduct his business from an office building, with perhaps a storeroom at some point in the city where he obtains cheap rent. Thus will come about the segregation of this business—first, the manufacturer; second, the jobber; third, the contractor, and, fourth, the dealer and retailer.

Dealer and Contractor Identical

As it is to-day the words contractor and dealer mean practically the same thing. The majority of contractors are dealers, to a certain extent, and, so far as I know, all dealers are contractors. So in speaking of the relationship between the jobber and contractor I include the dealer in the same class with the contractor.

The dealer of to-day and the dealer that we will have with us to-morrow, of necessity, have to carry a certain assortment of stock, and on staple items do, and will always buy in quantities sufficient to get them the best price obtainable from the jobber. With them this is quite necessary, as competition at the present stage of the game, not only with themselves, but with many of the jobbers, is very keen, and as they have a very much higher overhead expense to stand than the true contractor who operates from an office. To play a safe game, the true contractor should confine his purchases to exactly what he needs for certain jobs, excepting, of course, that it is policy to combine the purchases for a job ready to-day with the requirements of a job which you actually have ready for to-morrow. In buying your requirements for actual work on hand you many times will pay more for your purchases than will the dealer who buys in large quantities, and you may think that this condition gives this dealer who is at present doing contracting work an advantage over you, but such is not the case, as the dealer has additional overhead charges to meet which more than offset the difference in quantity price, and, furthermore, when he takes an inventory, he has a large portion of his assets tied up in merchandise, while the true contractor has his assets in accounts receivable or uncompleted contracts. I believe that the time is fast approaching when this segregation of the dealer and contractor will be recognized by the majority as the most economic manner of conducting this business.

The one great trouble with the contractor, next to the lack of capital in starting his business, has been this tying up of money (either his or his creditors) in stocks of goods which, on account of changes in the code or changes in demand, have become practically worthless, and, as a result, the contractor has been carrying them along on his books as an asset, fooling himself and fooling his creditors. Accounts receivable certainly shrink fast enough in case of liquidation, but stock on the shelves shrinks many times faster.

Support the Jobber

When the time comes that such retail stores as I have mentioned are established, then the time is ripe for the jobber to withdraw into the wholesale district or suburban district and get out of the location of high rents, which at this time is one of his principal bug-bears. Under such conditions I cannot conceive of any valid reason why both the contractor and the dealer should not give their entire support to their local jobber, as he would become virtually their warehouse and would perform a service for them, and does to-day, for that matter, that is certainly commensurate with the returns which he gets. A better support by the contractor and dealer to the jobber in his own centre enables that jobber to get together a better stock and thus becomes of more value to the contractor or dealer. A lack of this support in the past has been the cause of considerable friction and has resulted in some jobbers being competitors of contractors and dealers and has caused some dealers to compete with the jobber. This competition by the dealer with the jobber has been made possible by cheaper lines of electrical merchandise and supplies which have been on the market, but primarily by the fact that the dealer would buy in maximum quantities and then job out goods so purchased in small quantities at prices less than the jobber saw fit to handle them. To my notion, the dealer who does this is making a mistake, as the jobber who maintains his prices based on quantities delivered at one time gives the best possible protection under present conditions to the retailer.

If the time comes when all jobbers can be wholesalers in the true sense of the word and not be tempted by the retail business, it will then be possible for them to market the goods which they carry to you at two prices only, that is, an unbroken standard package and a broken package. If such a schedule were put in to-day by all the jobbers located in the business sections of their various cities it would mean that the retailer would be out of business and the jobber would lose money, as his expenses would then be the equivalent of the retail business.

It may possibly be that I am entirely wrong as to what is forthcoming in the jobbing, contracting and dealer's business, as there seems to be a very strong movement on foot to-day to absolutely dominate the electrical business from its point of manufacture until it passes into the customer's hands. The only link that is lacking in this chain is the contractor's link, as this chain now has in its make-up the manufacturer, the jobber and dealer and the central station.

Coming back to the relations between jobbers and contractors, I believe that their business relations should be mutually enjoyable, that there should be a personality in the relationship, that there is more to the business than buying and selling, and that the jobber and contractor should strive to gain mutual confidence one in the other. Be broad enough minded to not feel hurt when your jobber asks you for money. This request is not intended as a personal insult, but, like you, he needs money to run his business and there is nowhere else that he can look for it except from whom it is due.

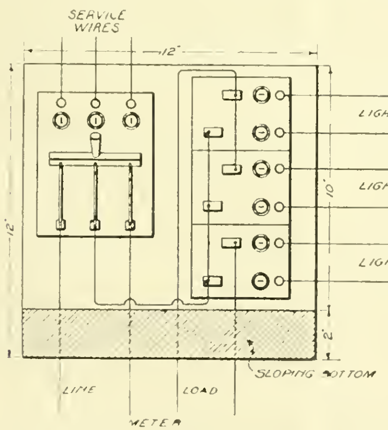
In closing, I wish to say I have faith in my business when properly conducted. I have faith in your business when properly conducted. I have faith in the policy which I have to-day outlined to you and my efforts in carrying out this policy, in so far as my company is concerned, will be evidence to you as to how sincere my faith is.

Cut-Out Cabinets

The Electrical Review prints the following interesting article by Mr. R. H. Eddy on the subject of "Cut-out Cabinets," having special reference to house wiring of the smaller class.

In the usual course of knob-and-tube wiring the cut-out cabinet is built into the wall of the house which is being wired by putting in headers between studdings, furring up the openings, and then lining with asbestos. This arrangement leaves any and all sizes of openings to be incased and covered with doors. Each wireman builds his cabinet to suit his own fancy, as a rule, and usually forgets to keep a record of the dimensions of the opening for which the door is to be made, or, if he does keep such a record, he is quite liable to forget to turn it in at the proper time. Then when the job is ready for the finishing touches—in the town where the writer works no lights are allowed to be turned on until the work is finished—another workman is sent out, who, after completing everything but the cabinet door and trim, takes the measurements for the door and brings or sends them to the shop. The shop orders the special door needed from the mill or from some carpenter, and finally has to have a man make an extra trip to the building to install it. Thus this lack of standard practice in the matter of such cabinets is almost sure to result in what is really an unnecessary loss of time and money.

In order to avoid such unnecessary loss, the workmen whom the writer employs are instructed to follow certain dimensions which are considered standard in our shop. Consider, for example, a house having eight rooms, and in which fewer than 36 lamps are to be installed. Our rule is



that the cabinet opening must be 12 by 12 ins., and arranged to take a standard entrance switch and three two-wire single-branch cut-outs and allow for a two-inch slope at the bottom of the cabinet, there being left a working space 12 by 10 ins. on the back surface.

The next three sizes for cabinets are 12 by 15, 12 by 18, and 12 by 24 ins., respectively, the dimension given being intended to be applied to cased openings. It will be noted that the dimension 12 ins. is retained throughout; this is necessary because carpenters do not always allow 14 ins. between studdings.

By following this system, we find it convenient to order cabinet doors and trim by the hundred, and to get them for about half the price they formerly cost us.

This matter of following systematic plans in the installation of cut-out cabinets is something the electrical contractor can ill afford to neglect. A properly installed cabinet, with neat door and trim, and with the wires running directly out from the connections, and the contractor's name plate on the door is a standing advertisement for future business.

It is highly desirable that cabinets be built in the shop, and there lined, fitted, and connected up with three service wires, each slightly more than eight feet long coming out at the top, and a meter loop at bottom. When delivered to the workman on the job in this shape, the cabinet can be installed without loss of time. Building cabinets in the shop prevents waste of material, saves time and insures a better grade of work than it is reasonable to expect when they are built at the house where they are to be used.

In the accompanying figure the arrangement of cabinet and cut-outs which the writer prefers is indicated. The panel door is 12.5 by 12.5 ins., forming a half-inch rabbet with the casing, against the ground strips and plaster. The cabinet is 3 ins., deep in the clear. For casing, 4 ins. is allowed, and there is 1 in. clearance for the wires. Meter wires should be 18 to 24 ins. long. If neutral wire is required for the meter, it should be looped under the central contact on the service switch and then dropped through bottom to the meter outlet.

Lion-M Tungstens

Mr. John B. Neale, Electrical Products Company of Canada, has just renewed his contract with Messrs. Mix & Genest, of Hamburg, Germany, manufacturers of the celebrated Lion-M tungsten lamps. Mr. Neale has the sole selling rights for these lamps in Canada, and has recently appointed Messrs. Miller and Miller, of Edmonton, as his agents for Edmonton and Calgary. He reports that since taking this agency they have secured some very good contracts, one being for the installation of lamps in the Y.M.C.A., Winnipeg. Mr. Neale has also appointed Messrs. C. T. Inman & Company, 157 James street south, Hamilton, as his agents for that city. Mr. Neale leaves shortly on a business trip to Germany.

Have Increased Capital

The Thompson Electric Company of Cleveland, Ohio, announce that they have increased their capital from $10,000 to $150,000, to provide for increased business. Mr. A. J. Thompson, president of the company, is well known to the trade, as is also Mr. Chas. E. Pope, secretary and treasurer of the company, who was formerly mechanical engineer with the National Malleable Castings Company of Cleveland. The company manufacture the Thompson automatic safety cut out hangers for arc lamps and large tungsten units and clusters, and will shortly place on the market a high voltage series cut-out hanger for street lighting.

New Appleton Ground Clamp

A new ground clamp has been placed on the market by the Appleton Electric Company, 212 North Jefferson Street Chicago. This has met a demand among electrical contractors for a clamp which can be more readily applied. The device is made in a single piece of sheet steel and designed to fit three-eighths-inch or one-half-inch conduit. The clamp is always very accessible and when put into a box it can be tightened to the gas pipe with an ordinary screw driver.

The city of Lethbridge has engaged Mr. R. A. Ross, of Ross & Company, consulting engineers, Montreal, to investigate and report on the cost of producing electric power from (a) natural gas; (b) run-of-mine coal, and (c) slack coal.

Current News and Notes

Amqui, Que.

An electric lighting plant is contemplated

Berlin, Ont.

Two new cars of the Preston type have just been placed in operation on the Berlin and Waterloo road. It has been decided to inaugurate the p.a.y.e system on this line, beginning April 1st.

Brandon, Man.

The city council awarded the contract for motor generators for the power plant in connection with the street railway system to the Canadian General Electric Company.

The Brandon Street Railway system will be further extended as far as the Dominion Experimental farm in the northwest part of the city.

The street car bodies for the new municipal railway system which are being manufactured by the Niles Manufacturing Company, of Iowa, will shortly be shipped to Winnipeg and equipped there with electric motors and accessories. These latter are being supplied by Canadian firms.

City Electrician Skead has planned a large electrical sign for Brandon, which will be used first during the Dominion Fair, but will be a permanent installation. Mr. Skead's suggestion is a circle 30 ft. in diameter with letters 18 in. in height. It is calculated that 1260 two-candle power lamps would be required and that the total cost would be about $2,000.

Mr. O. L. Boyd, late Winnipeg representative of the McDonald & Willson Company, has formed an electrical contracting company to be known as the Boyd Electric Company, Limited. This new company will operate in Brandon, Man., where Mr. Boyd believes there is a fine opening for electrical equipment.

Brechin, Ont.

The by-law to enter into a contract for the supply of Niagara power carried by a vote of 23 to 18.

Calgary, Alta.

Mr. R. A. Ross' report on the power situation is said to state that Calgary is receiving power from the Calgary Power Company at approximately as cheap a rate as it can be produced by burning gas under the furnaces. Calgary has talked of $10 power with the advent of cheap gas, but Mr. Ross does not think this is possible. The report suggests the insertion of rather stringent penalty clauses in the new agreement, in case of failure of the Calgary Power Company's lines. At the present time the Calgary Power Company's service is not as satisfactory as it might be, but it is believed that, with the duplicate plant in service, a continuity of supply can be guaranteed.

A decision has been reached to organize the nineteen sections lying just to the east of this city into a town municipality to be known as East Calgary for the purpose of raising money by debentures to bring in natural gas from Bow Island and build up a big industrial community. The population of this district is about 2,000, which is sufficient for the suggested purpose.

Cayuga, Ont.

By-law carried by ratepayers to take power from Hydro-electric Commission.

Dalhousie, N.B.

Tenders are called to March 5 for the supply of complete equipment for an electric light system for the town of Dalhousie, N.B. The engine capacity required will be 150 h.p. and the generator 100 h.p. Chipman & Power, civil engineers, Mail and Empire Building, Toronto, have charge of the installation.

Edmonton, Alta.

Telephone equipment estimates for 1913 include terminals and switches, $133,652; telephones and installations, $85,000; branches and materials for underground cables and aerial lines, $630,000.

Street railway estimates for 1913 include rolling stock, $350,800; permanent track work, $630,000; extensions, $144,000; special tracks, $106,200; sub-stations, $62,250; high level bridge, $62,000.

The commissioners have reported favorably on extensions to the street lighting system amounting in cost to some $186,000.

The street railway system of this city was operated for the year at loss of about $25,000. This is the result largely of running a number of lines into suburban districts for the purpose of increasing land values. It is hoped that by charging a straight 5c rate, and making only judicious and economical extensions in future, the system can be put on a paying basis without much delay.

The operations of the municipal power plant for the year show a profit of something over $13,000.

Estevan, Sask.

The felling is very optimistic that power will be obtained in the not distant future for this and other cities in Saskatchewan from the lignite coal fields to the south. It is said that a company has been organized with $2,500,000 capital to buy land and install producer-gas equipment for generating power.

Fingal, Ont.

The Fingal Telephone Company contemplates extending its lines into the Port Stanley district and will require equipment.

Fort Frances, Ont.

Telephone system—time extended for receiving tenders from February 1st to March 1st.

Fredericton, N.B.

Some additions are being made to the arc lighting street system. It is also suggested that the town should utilize an old generator already in its possession for applying the current to the street lights and for other municipal requirements.

Hamilton, Ont.

It is said the Hamilton Street Railway Company will build five or six miles of extensions, work to start in spring; new cars will be required later.

There is much opposition to, and apparently very little support of, a duplicate telephone system in this city.

Listowel, Ont.

Purchase of electric lighting equipment is contemplated.

London, Ont.

The city council will ask the legislature for power to take a vote on the question of electrifying the London & Port Stanley railway.

It is reported that double tracking will be done in several parts of the city, and that 80-lb. rails, frogs, etc., will be required.

Negotiations are said to be under way looking to an arrangement between the C. N. R. and the London & Port

Stanley Railway Board. The road may either be leased or sold to the company. Before any agreement can be ratified, however, the matter will be submitted to the ratepayers as an alternative to the scheme of electrification.

It is said plans are to be prepared and equipment purchased for developing 500 horse power at Springbank pumping station.

Macklin, Sask.

The town council is considering the erection of an electric light plant this year.

Medicine Hat, Alta.

A contract has been awarded by the government for the installation of an automatic telephone system in Medicine Hat.

Montreal, Que.

The Bell Telephone Company has made application to council to install underground wire in conduits on twenty streets.

It is reported that the Montreal Light, Heat & Power Company will soon issue some additional stock, rendered necessary by extraordinary expenditures, including a new gas plant at Cote St. Paul, estimated to cost two million dollars, and the addition to the head office building.

The Montreal offices of the Canadian General Electric Company, Limited, and the Canada Foundry Company, Limited, have been removed from 81 St. Peter street to 162 St. Antoine street west.

North Toronto, Ont.

The city's application to the Dominion Railway Board, asking that the Bell Telephone Company be directed to apply to North Toronto the same rates that prevail in the older portion of the city, came before the Board on Friday, February 7. The company conceded a reduction amounting to $20 a year. Judgment of the Board not yet announced.

Ottawa.

The city has applied to the Hydro-electric Power Commission of Ontario for an extra 1,000 h.p. of energy. The present contract calls for 4,000 h.p. and as the municipality is using well up to this amount, it has been deemed advisable to make application as above.

One-quarter of a mile of ornamental iron standards and five-light clusters for Sussex street is proposed, also transformers, meters and general electric equipment.

Assemblyman Patrie of the New York Legislature has introduced a bill to appropriate $282,000 to defray the expenses of a hydro-electric power development at two points in the state.

An interesting lecture was given before the Ottawa branch of the Canadian Society of Civil Engineers on Friday, February 7th, by Mr. A. A. Dion, manager of the Ottawa Electric Company, on Electrical Underground Conduit Construction.

Porcupine, Ont.

A novel use was recently made of electricity in connection with a strike in one of the mines when a number of wires were strung around an area where a number of strike breakers were operating. These wires were then charged (or said to be) with electricity, and signs to that effect and drawing attention to the danger of approaching were hung from the wires. It is said that there was no difficulty experienced in keeping the strikers from interfering with this mine.

Prince Albert

The city of Prince Albert has completed its first installation of 129 ornamental tungsten standards. Work commenced October 15, 1912, and the lights were turned on December 28th. The cable was supplied by the Canadian British Insulated Company, and the standards by the Union Metal Company. It is said to be the present intention to install 150 more of these standards during 1913.

Regina, Sask.

The heads of the different utilities are asking to be given full control of their departments, this to include all accounting and other work in connection with it, the same as if the utility were separately and privately owned. City Electrician E. W. Bull is head of the electric light department, and Superintendent Doughty of the street railway department. It is understood that this system will be adopted.

Reserve Mines, N.S.

It is said the Cape Breton Electric Company, Sydney, N.S., will install railway motors, add railway feeders, machine equipment, erect two storey addition to present warehouse and freight shed, new telephone despatching system for Glace Bay, improvement to Sydney power station, switchboard, special railway work, etc. Manager, E. L. Milliken.

Rossland, B.C.

The annual report of the West Kootenay Power & Light Company for the year ending August 31, 1912, shows assets to the amount of $4,134,737. The gross receipts for the year were $332,864; operating expenses, including maintenance, repairs, etc., $110,257. The capital of the company is represented by $1,500,000 bonds, $300,000 in preferred shares and $2,000,000 in common stock. A dividend of 2½ per cent. was paid on the latter.

Saskatoon, Sask.

By-law was submitted on February 11 to raise $100,000 for extensions to street railway system.

On February 11, the electors voted on a by-law to raise $150,000 for the extension of the electric light and power system.

A committee will be appointed to go fully into the matter of development of hydro-electric power on the Saskatchewan River. This committee will be given power to engage whatever expert opinion is deemed necessary for a full and complete investigation and report.

St. Catharines, Ont.

The Hydro-electric Power Commission has made an offer of 2,000 h.p. to St. Catharines at a $14 rate.

St. Charles, Man.

An electric lighting plant is contemplated by the rural municipality of Assiniboia. Internal combustion plant favored.

St. John, N.B.

Opposition is being raised to the damming of the St. John River by the St. John River Hydro-electric Company on the ground that it will interfere with the salmon fishing industry by preventing the fish from passing up the river in the spring time to spawn, as is their usual custom. This company propose to dam the river about forty miles above Fredericton for power development purposes.

The proposed street railway extension to Kane's Corner with double tracking on Brussels street is still under discussion.

The Dominion Coal Company will install at their new coal docks at St. John, N.B., four vertical submerged tubular boilers built for 150 pounds working pressure by the International Engineering Works, Limited, manufacturers of Robb engines, boilers, etc.

St. Johns, N. F.

The Reid Newfoundland Company, St Johns, Nfld., have recently purchased from the Westinghouse Electric &

Manufacturing Company, one double equipment of No.323-A motors and 200-D-2 type control.

St. Thomas, Ont.

The Dominion Railway Commission have granted to the St. Thomas Municipal Street Railway System a right to cross the M. C. R. tracks at William street. The city pays the cost of installing the diamond and the city and railway company share equally the maintenance of the switches.

Sudbury, Ont.

The Wahnapitae Power Company has increased its capital from $250,000 to $500,000.

Tilbury, Ont.

Steps are being taken in this place to obtain power from the Hydro-electric Power Commission of Ontario.

Toronto, Ont.

The gross revenue of the Toronto Railway Company for the year 1912 was $5,448,050 as against $4,851,541 in 1911. During the past year 135,786,573 passengers were carried as against 120,997,844 in the previous year. The city's share of the gross receipts totalled $942,049, an amount considerably in excess of the dividends paid on the total capital stock of the company. Ten years ago the gross earnings of the Toronto Railway Company were $1,834,908, exactly one-third of to-day's total.

On Commissioner of Works Harris' suggestion a traffic manager will be appointed for the civic lines. It is understood that the p.a.y.e. system will be installed on civic lines as quickly as possible.

A route map of the proposed municipal railway connecting Toronto and Port Perry has been drawn up and includes besides the towns of Markham and Stouffville a number of similar places such as Unionville, Hagerman, Milliken, Agincourt, Ellesmere, Green River, Greenwood, Brooklin, Locust Hill, Balsam, Ashburnham, Goodwood, Claremont, Altona, Ringwood and Uxbridge. The government was asked for a bonus of $6,500 per mile.

Tenders will be received by the Hydro-electric Power Commission of Ontario until March 17th for galvanized steel towers, special crossing towers, copper cable, aluminium cable, insulators, galvanized malleable iron clamps, galvanized pressed steel clamps.

A number of suburban districts have been mapped out in which street lights will be installed as soon as possible. These include the Swansea district, 50 lights; the Runnymeade district, 50 lights, and the Todmorden district, 82 lights.

A minority report has been filed by Mr. Petrie, a member of the Joint Committee of the New York State Legislature on the conservation and utilization of water power, which favors the adoption of a system in New York similar to that operated by the Hydro-electric Power Commission. Mr. Petrie's report states, among other things, that "the Ontario system tends to develop to the fullest extent the manufacturing and commercial industries of the province."

Vancouver, B. C.

During the month Mr. Justice Murphy rendered a decision in the action of the Burnaby municipality against the B. C. Electric Railway Company. This action dismissed the application of the municipal authorities who requested that the franchise of the company in Burnaby municipality be quashed and an injunction be issued restraining the company from operating tram lines in the district. The franchise agreement which was the subject of the action, was granted by the Municipal Council without reference to the electors, in 1909. Since that time the question as to the validity of the franchise has been constantly under discussion. The company now operate an interurban line through Burnaby, but this route is covered by a line operated under a Dominion charter. No action has yet been taken by the Burnaby authorities concerning the appeal from the decision.

Walkerton, Ont.

Ratepayers voted on by-law to extend electric lighting system and grant franchise for five years.

Welland, Ont.

A deputation from this place recently waited on the chairman of the Hydro-electric Power Commission of Ontario with reference to the supply of another 7,000 horse power of electric energy for this town. Thorold also is negotiating for about 2,000 h.p., and if St. Catharines joins the hydro scheme, this will bring the total added requirements in this section to 11,000 horse power.

This municipality has purchased the complete distribution system of the Ontario Power Company within the town limits of Welland, including a sub-station and all auxiliary equipment as well as the distribution throughout the town. This will form a nucleus to a municipal system to which additions will be made as business requirements demand. The contracts held by the Ontario Power Company are also taken over by the municipality. It is understood the rate of power to Welland will be $14.

It is said that requests in this district for additional power supplied from the Ontario Power Company, have been met with the statement that this company is not in a position to supply any additional power in the Welland peninsula.

Westboro, Ont.

A complete electric lighting system for this village is under discussion.

Winnipeg, Man.

Tenders are received until February 14 for one 9000 kw. transformer. Specifications at office of engineer.

Tenders are called for electrical machinery, equipment and tools required in connection with Kelvin and St. John's Technical High Schools.

A contract has been awarded to Head, Shannon & Head, 410 McArthur Building, for an extension to McPhillips street power sub-station to provide for extension of street lighting system.

Enlarging Municipal Plant

At the meeting of the Ottawa City Council on Monday, February 3rd. it was decided to apply to the Ontario Railway and Municipal Board for authority to issue debentures for $150,000 to provide for enlarging the plant of the municipal electric plant as well as enlarging the present building.

Electrical News
Generation, Transmission and Application of Electricity

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The Micro-thermometer

The Department of Marine & Fisheries has just issued a report of experiments performed with Professor Barnes' micro-thermometer, on an instrument devised to determine the presence of icebergs. The report deals with readings taken on a trip of the C.G.S. Montcalm and on a trip across the Atlantic on board the R.M.S. Victorian. Some extremely interesting and unexpected results are obtained not the least unexpected being the temperature conditions found in the immediate neighborhood of icebergs. In every case as an iceberg was approached it was found that the temperature increased almost uniformly to the extent of about a degree over a five mile circle surrounding the iceberg. This rise in temperature was very marked on the micro-thermometer, which is a very sensitive instrument, and occurred without exception in every set of readings taken as the ship either approached or left a berg so that Professor Barnes is satisfied his instrument will detect the presence of icebergs without fail. In view of the success of these experiments it is evident that much added safety would result in the general adoption, by all steamships, of this device.

In theory the micro-thermometer is a very simply designed apparatus. It consists of a coil of wire of approximately 125 ohms resistance which is enclosed in a metal bulb and placed just below the surface of the water at the side of the ship. This coil constitutes the resistance in one of the four arms of an ordinary Wheatstone bridge. Two of the remaining arms carry constant resistances, the third arm being variable. As the temperature of the water varies the resistance of this coil also varies so that the temperature of the water is easily calculated from the resistance readings taken.

Thury System Favored

A report has just been made to the Government of Sweden by Messrs. Holmgren and Centerwall, engineers, on the question of the transmission of 20,000 kilowatts of electric energy, a distance of some 200 miles, between Trollhatten in Sweden to Copenhagen in Denmark. The report deals with the type of generation and transmission best suited to the particular conditions existing on this line which are unusual in that the Strait of Oresund, 3½ miles wide, has to be crossed on the way. The difficulty of transmitting alternating current across this Strait was the chief obstacle and probably the determining factor in the final recommendation of a transmission at 90,000 volts direct current.

At Trollhatten it will be remembered there is a present development of 80,000 h.p. with sufficient power for 20,000 h.p. addition. Generation is at 25 cycles and the Copenhagen requirements are for 50 cycles. As the requirements of Copenhagen are approximately this 20,000 h.p., the question resolved itself into the most economical method of developing this amount at Trollhatten, transmitting it to Copenhagen, and transforming to 50 cycle a.c. current.

Three general plans were considered as follows: First, the cost of generating and transmitting direct current and converting it into 50 cycle a.c. current at Copenhagen; second, the cost of generating alternating current converting it into direct current at Trollhatten, transmitting by direct current and eventually converting back to 50 cycles at Copenhagen, and third, cost of generating and transmitting alternating current and eventually converting it to 50 cycles at Copenhagen.

The estimated cost of the three systems is given below. Estimates were made on both a wood pole and an iron pole transmission line for the direct current transmission, also a ground return and metallic return. It will be seen from these figures that the direct current system of generation and transmission possesses decided advantages in cost over the other methods discussed.

	Total cost. dollars	Annual Expense dollars	50 cy. current available at Copenhagen kw.
Generate d.c.; transmit d.c.			
Wood poles, ground return ..	1,202,000	125,000	11,225
Iron poles, ground return	1,269,200	130,500	11,225
Wood poles, metallic return .	1,643,700	157,300	10,830
Iron poles, metallic return ..	1,715,300	163,300	10,830
Generate a.c.; transmit d.c.			
Wood poles, ground return ...	1,350,600	141,800	10,040
Iron poles, ground return . .	1,418,600	147,200	10,040
Wood poles, metallic return ..	1,782,700	174,500	9,640
Iron poles, metallic return ...	1,862,000	180,800	9,640
Generate a.c.; transmit a.c.	1,593,000	163,000	10,440

The system of generation recommended therefore, is that known as the Thury system. Instead of two turbine units as originally planned, there would now be four, each driving five generators in series, each generator wound for 4,500 volts. These 20 generators coupled in series would give 90,000 volts at which pressure it is proposed to transmit.

Smoke and Sawdust Abatement

A civic committee which for some months past has been in operation as a "Smoke and Sawdust Abatement Nuisance Committee," at Vancouver, to consider ways and means to obviate those two evils in the city, recently concluded its labors by recommending to the council a proposal from the Public Service Corporation to supply electric light, heat and power to consumers in the city. It is the intention of the company to develop electricity and steam heat from the refuse at the various lumber mills in Vancouver and at the

same time do away with a great deal of smoke and sawdust. Broadly speaking, the recommendations of the civic committee were as follows:

The franchise is to be for thirty years, but the company is to have no exclusive right for such a franchise. The city is to have the option of purchasing the company as a going concern after twenty years, and at the end of each succeeding five-year period. Disputes as to price are to be settled by arbitration.

The supply charges to consumers are to be: For electric light, 8 cents per kilowatt hour, to be subsequently reduced to 7 and 6 cents; for heat $1.00 per 1,000 pounds of steam pressure developed by the company. A discount of 10 per cent. if bills are paid within ten days. No meter rents.

In consideration of the franchise the company are to pay the city 1 per cent. on the first ten years' gross earnings, 2 per cent. on the gross earnings for the ensuing five years, and 2½ per cent. for the balance of the term; they also must start operations within 18 months and expend $50,000 within this period, otherwise the agreement will lapse.

Large Producer-Gas Plant

The Canadian Car & Foundry Company of Fort William, Ont., have recently installed three-600 kw., 60 cycle, 3-phase, 500 volt a.c. generators. The generators will be driven by producer gas engines and it is claimed that this will be the largest producer gas engine plant in Canada. The engines are being supplied by the Mesta Machine Company of Pittsburgh, Pa., and are of the single tandem, horizontal, double acting, 4 cycle type, cylinders 28 ins. diameter by 36 ins. stroke, to operate at a speed of 150 r.p.m. The main gas plant consists of four double bituminous coal generator sets furnished by the R. D. Wood & Company, Philadelphia, Pa. This gas plant was originally intended for fuel gas purposes, but as it is necessary to intermittently change from the water gas operations to producer gas, it was decided to utilize the waste, or producer gas for power purposes. This gas will contain more than 10 per cent. hydrogen by volume and is particularly suitable for use in gas engines.

The fuel gas which will be used for furnace work will have a heat value of 300 B.t.u. per cubic foot, and will contain 50 per cent. hydrogen and 50 per cent. of carbon monoxide. The operation of the producers will be such that it will be practically impossible to mix the gases, that is to say, the regulation of the gas will be automatic, eliminating any liability of water gas being carried to the engines. In the use of double generating sets the gas is drawn off the top of one generator and down through the incandescent coal mass of the other, the tar being consumed and converted into gas, thereby increasing the efficiency of the plant. The resulting deposits of soot will be disposed of through a Thiesen washer.

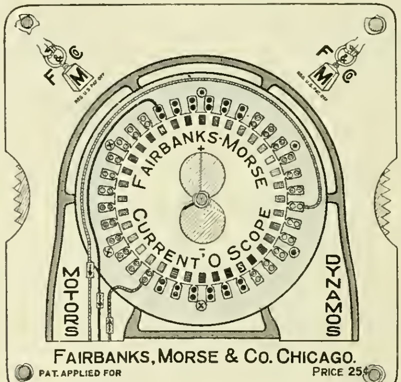
Revolving Field in Induction Motor

We illustrate herewith a device which shows graphically how the revolving field is produced by the action of alternating currents in a three-phase a.c. induction motor. This device is a very clever scheme gotten out by Fairbanks-Morse & Company and named by them the Fairbanks-Morse Current 'o Scope. It will be found especially valuable for students or others who are desirous of obtaining an insight into the theory underlying the operation of induction motors.

An induction motor is in general made up of a stator into which a three-phase alternating current is fed and a rotor containing coils of wire short circuited on themselves. As the current in any phase passes through its different values a condition is created in this stator which is equivalent to a revolving magnetic field. At the same time induced currents in the rotor produce a magnetic field which interacts with the magnetic field of the stator and so produces rotation. It is to study these conditions graphically that this new device has been worked out.

The cut shown herewith is not a fair reproduction of the original device in that the original is made up in colors—black, red and green representing the different phases. The colors are also used for other distinguishing purposes. A fair idea of the work of the device may however, be obtained from the following brief description.

In the centre of the Current 'o Scope there are two circular openings through which will be seen three radial lines representing three phases. These three lines, together with the arrows and signs spoken of later are painted on a circular disc which revolves on a central axis behind the openings shown in the figure.



When a line appears in the upper circle it is taken to indicate a current in the positive direction and a line in the lower circle represents a current in the negative direction. Also the length of the lines is calculated to represent the strength of the current at any instant. It will be seen that by revolving this disc the length of the lines will vary from a maximum positive to a zero value, to a maximum negative, back to zero, and finally to a maximum positive again. This represents one cycle. In the same way by turning the disc through stated angles the relation of the current values in the three phases at any instant can be determined.

The outer part of the diagram shows the frame, core and windings of a two-pole, three-phase induction motor. The arrows running around the core on the left hand side indicate the lead wires. As the disc is turned arrows appear through the slots as indicated, which show the direction of the currents in the different phases at any instant. Crosses, dots and zeros also appear through the openings as shown to indicate the direction of the current, a cross meaning that the current is flowing away from the observer, a dot indicating currents flowing towards the observer, and a zero indicating no current. The shaded portions of the disc, which in the original are red and black, show through the inner rectangular slots and indicate the strength and direction of the magnetic field produced by the combination of currents flowing in the three phases. The deeper shaded portions where the letters N. & S. appear indicate the point of maximum field strength, and the lighter shaded portions indicate the gradual weakening of the field on either side of these points.

Victoria has eight public charging stations for electric pleasure cars and trucks.

Telegraph Statistics of Canada

A copy of telegraph statistics of the Dominion of Canada for the year ending June 30th, 1912, is just to hand. The statistics were obtained from telegraph companies under authority of an amendment to the railway act passed by parliament in 1911 and is therefore the first statistical report on the telegraph interests of Canada. The statistics, however, are not complete in that they relate only to companies engaged in the commercial telegraph business and have no reference to railway telegraph interests. However, where companies conduct both a commercial and a railway telegraph system a report has been made on the commercial end of the business.

Geographically, it might be said that the Maritime Provinces are served by the Western Union, the Canadian Pacific and the Anglo-American Companies, although the last named is leased and operated by the Western Union. The Dominion Government operates lines in the unsettled sections of the lower Provinces, chiefly as aids to navigation. The Central Provinces of Ontario and Quebec are served by the Great North Western, the Canadian Pacific and the North American Companies, as well as by the Temiskaming & Northern Ontario Railway Commission. The Western Provinces have the lines of the Canadian Pacific, the Great North Western, the Grand Trunk Pacific, the Canadian Northern and the Dominion Government.

The pole mileage operated in Canada for commercial purposes according to the report amounts to 40,785; the wire mileage to 167,939. These figures are made up as follows:—Nova Scotia—pole mileage 2,828, wire mileage 9,878; New Brunswick—pole mileage 1,867, wire mileage 8,376; Prince Edward Island—14 miles and 14 miles; Quebec—7,515 and 24,249 miles; Ontario—10,514 and 58,207; Manitoba—3,803 and 18,184; Saskatchewan—5,382 and 21,257; Alberta—2,895 and 14,491; British Columbia—3,467 and 10,571; Yukon—2,498 and 2,713. It will be seen that there is an average of a little over four wires for each pole represented. The public service of telegraph companies operating in Canada was represented in the transmission of 9,252,540 land messages and 768,559 cablegrams during the year. The total number of employees reported was 4,828; the salaries and wages paid, amounted to $2,703,032.

The report contains also a quantity of interesting historical information with reference to the early days of the older companies. In this connection the following paragraph will be of interest as showing that the first Canadian telegraph line was operated in 1846. In the United States a line had been opened for public business one year earlier. It was written by Mr. A. F. Easson, whose association with Canadian Telegraphs dates back as far as 1849.

"As early as 1846, T. D. Harris, a hardware merchant of Toronto, and a few public spirited Canadian gentlemen associated themselves into a company to secure the construction of a line of Morse telegraph between Toronto and Niagara, via Hamilton and St. Catharines. The money needed was easily raised, and when at last the company was fully organized it was named 'The Toronto, Hamilton, Niagara & St. Catharines Electro Magnetic Telegraph Company,' with a capital of $16,000, and for which a suitable charter was procured. The line was built by Samuel Porter, long and favourably known in United States telegraphic circles. It will be remembered that a telegraph line between Washington and Baltimore was first opened for public business in the United States on April 1st, 1845. Up to that date the line had been worked by Prof. Morse and his associates as a curiosity. Mr. Porter suspended a wire across the Niagara River to connect the wire at Queenston with Lewiston, N.Y., and built for this first Canadian telegraph company an honest and well appointed line."

Personal

M. Jno. W. Williams, secretary-treasurer the London Street Railway Company has resigned.

Mr. A. G. Sangster, electrical superintendent for the last three years of the Saskatoon municipal system, has resigned.

Mr. Albert Wheaton, electrical inspector for Saskatoon for the past eighteen months, has resigned to go into private business.

Mr. Edward Hanson, late of the Montreal Light, Heat & Power Company, has been appointed electrical superintendent of light and power in Saskatoon.

Mr. R. M. Hannaford is acting chief engineer of the Montreal Tramways Company, following the resignation of Mr. J. D. Evans, chief engineer, a few weeks ago.

Mr. Louis W. Pratt has been appointed sales manager of the Hamilton Cataract Power, Light & Traction Company, Limited, with Mr. W. E. Goring, assistant sales manager.

Mr. White, formerly superintendent of the city electrical department, Saskatoon, has been appointed superintendent of the new street railway system which went into operation there January 1.

Mr. Frederic Nicholls, president the Canadian General Electric Company, visited Vancouver recently in connection with the affairs of the company. The C. G. E. has a branch at 1065 Pender street west, Vancouver.

Mr. W. A. Ostom, chief electrician in the Saskatoon power house for the past year, has resigned to again enter the employ of the Canadian General Electric Company, as superintendent of construction in the west.

Mr. R. H. Sperling, general manager of the B. C. E. R. Co., spent a few days with the Victoria officials at the end of January. Mr. Sperling was much pleased with the progress in Victoria since his visit to England.

Mr. F. J. Gibbons has been appointed sales manager of the Jefferson Glass Company, succeeding Mr. Griffith who is returning to the United States. Mr. Gibbons was formerly sales manager of the Macbeth-Evans Glass Company.

Mr. Julian C. Smith, superintendent of the Shawinigan Water & Power Company, Montreal, has been made a member of the Institution of Electrical Engineers. There are now eight members in the Dominion of Canada.

Mr. Seth B. Smith, who until recently was the Vancouver manager of the Hinton Electric Company, Victoria, is now the Vancouver representative of the Canadian Moloney Electric Company of Windsor, Ont., with offices in the Vancouver Block.

Mr. R. S. Kelsch, Montreal, has left for a long holiday in the West. He has lately been under the weather but hopes to return with much improved health. Mr. Kelsch will visit, among other places, Vancouver, Seattle, San Francisco, and Los Angeles.

Mr. Alfred Still, chief electrical engineer to the Algoma Steel Corporation and for the past year located at Magpie Mine where he has had charge of the installation of a generating plant and transmission line, has resigned his position to associate himself with the School of Electrical Engineering of Purdue University, Lafayette, Ind.

Mr. Alvin Schlarbaum, B.A.Sc., '09, has severed his connection with Messrs. Smith, Kerry & Chace as assistant engineer on the Healey Falls development, to accept the position of hydro-electric engineer for the Riordan Pulp & Paper Company, Limited, of Hawkesbury and Merritton, Ont. The above company plan to develop 9,000 h.p. on the Rouge River to meet the demand of recent extensions to their plant.

Telephone Statistics

A copy of telephone statistics of the Dominion of Canada for the year ending June 30th, 1912, contains much interesting information on telephone operations during the past year. The number of companies making a statistical return to the government totalled 683, an increase of 146 over the previous year. It is not considered probable that the department has a complete list of telephone companies operating, as it is very difficult to get the names and addresses of all telephone organizations. The report however, is believed to give a reasonably full account of telephone interests in Canada.

In the provinces of Manitoba and Alberta practically all the telephone companies have been absorbed by the provincial governments. In Saskatchewan this process of absorption is in progress although there are approximately 200 distinct corporations still operating on an independent footing. In Ontario and Quebec the Bell Telephone Company operate by far the greater number of telephones but the number of independent systems is rapidly increasing. The conditions in the various provinces as regards companies and the number of telephones they operate is as follows:

Ontario—a total of 369 organizations made up as follows: Municipal 27, stock 133, co-operative 97, partnership 28, private 84. The total number of telephones in service is 172,506, of which the Bell Telephone Company have 119,843 These telephones are about evenly divided between central and magneto type, there being 89,875 of the former and 82,631 of the latter. Most of the central energy type are owned by the Bell Telephone Company, namely 81,967.

Quebec—the number of organizations is 62 made up of 23 stock, 12 co-operative, 3 partnership, 24 private. The total number of telephones in use is 66,575, of which 45,906 are central energy and 20,667 are magneto. In this case also, the Bell Telephone Company own a very great majority of the telephones or a total of 54,493 of which 44,900 are central energy type.

Saskatchewan—this province stands second in the number of organizations, which totals 206. This includes the government owned system, 4 municipal, 174 stock, 24 co-operative and 3 private. Out of a total of 16,670 telephones in service the government controls 11,014, leaving 5,656 to the other 205 organizations. With the exception of the government system which uses 5,401 central energy units, all the telephones in Saskatchewan are the magneto type.

Nova Scotia—there are twelve telephone organizations in this province operating a total of 14,520 telephones of which 14,098 are operated by the Maritime Telegraph and Telephone Company. As in the other provinces the smaller organizations use the magneto type instrument.

New Brunswick—there are seventeen organizations in this province operating a total of 12,893. Of this number 11,947 are owned by the New Brunswick Telephone Company, the largest number of telephones owned by any other company in the province being 327.

British Columbia—has 31,178 telephones divided among ten organizations. The largest of these is the British Columbia Telephone Company, Limited, with 26,486. The next largest company is the Kootenay Telephone Lines, Limited, with 1500, and the Okanagan Telephone Company, Limited, with 1300. This province operates a very large percentage on the central energy plan, the British Columbia Telephone Company alone having 21,683 of this type as compared with 4,803 magneto.

Alberta—as already stated the government telephone system has absorbed practically all the smaller organizations. There remains however, the city of Edmonton telephone department, still controlled by the city and operating 4,104 telephones. This is an automatic system. At Red Deer the Western General Electric Company, Limited, also operate 250 instruments. The government owns 11,447 instruments.

Manitoba—here also there are only two organizations, and these very small ones, outside of the government system. These are the Miniota and the Pipestone municipal telephone system operating respectively 360 and 378 instruments. The Manitoba government operates 38,797 telephones.

Prince Edward Island—there is only one private company operated, the Prince Edward Island Telephone Company with 1,208 instruments on its lines.

Summed up, of the total number of telephones in service in Canada, 370,884, 212,732 are central energy type and 158,152 are magneto. During 1912 there was an increase of 37,738 in the number of telephones operated by central energy and an increase of 30,387 in the number operated by magneto.

The total number of miles of wire is given as 889,572. This is divided into urban and rural as follows: urban 636,961, rural 252,610. This indicates that there is one mile of telephone wire in use for every 8.1 of the total population of the Dominion and one telephone for every 19.3. There was one telephone for every 2.3 miles of wire. The class of wire used was as follows: galvanized, 271,191 miles; copper, 20,096; overhead cable, 232,393; underground cable, 364,875; submarine cable, 1,015.

The aggregate capital expenditure in telephones is now placed at $46,276,851, though the cost of real property is placed at something over $10,000,000 beyond this figure. This works out to a capitalization of $124.75 per telephone in use. The gross earnings from all telephone companies for the year amounted to about $12,250,000 as compared with a little over $10,000,000 in the previous year. Operating expenses were 74.0 per cent. of gross earnings as compared with 69.32 for the previous year. Gross earnings work out to $33.9 per telephone in use or $13.79 per mile of wire. Operating expenses represent an average of $24.52 per telephone or $10.22 per mile of wire. The total number of employees is placed at 12,783 as against 10,425 for the previous year.

Aluminium vs. Copper Conductors

In view of the large amounts of capital and engineering enterprise put forward in the development of schemes involving the generation and transmission of electric power in large quantities, the British Aluminium Company have prepared an economic analysis of the transmission line side of the question, dealing with the relative merits of copper and aluminium as the conducting material, and have incorporated the results in a publication called "Electric Power Transmission." It is pointed out that the fact that the over head link between the power plant and the sub-station is in many cases 200 to 300 miles in length and that its cost may be anywhere from $1,500 to $3,500 per mile is sufficient justification for drawing attention to this matter. It is emphasized that this economic question is vitally influenced by the choice of conducting material and that the results of careful study and comparison of engineers' reports from all parts of the world go to demonstrate that the use of aluminium as against copper is attended with economic advantages in almost every instance. At average market prices for the two metals the cost of bare conductors for the transmission of a given amount of power with a certain specified voltage drop is some 35 per cent. to 45 per cent. lower for aluminium than for copper. Pole lines erected for carrying aluminium conductors are, for technical reasons, somewhat the more costly, but the net result on the over-all cost is almost invariably in favor of aluminium. The following information taken from this publication has special bearing on the subject in question.

Properties of Aluminium and Copper

Under these circumstances especially, the very decided economy effected by the use of aluminium as against copper conductors is a powerful influencing factor, and in very frequent circumstances the deciding one. Many objections have from time to time been brought against the use of aluminium for bare conductors, but it may by this time be safely said to have lived them down. The fact that such extensive transmission undertakings as the City of Winnipeg hydro-electric undertaking, the Hydro-electric Power Commission of Ontario, The Pacific Gas and Electric Corporation, Energie Electrique du Littoral, Mediterranean, the Rjukanfos A.G. in Norway, and many other important concerns are using aluminium conductors almost exclusively is sufficient testimony to their merits. The principal characteristics of aluminium as an electrical conductor are here set forth.

Conductivity.—The conductivity of aluminium depends upon the purity, and, to a lesser extent, upon the amount of work put upon the metal in its evolution from billet to the finished wire or bar. For electrical purposes, the employment of aluminium of special purity only is recommended, as impurities or alloys of other metals increase the resistance, and are liable to introduce trouble from corrosion. An aluminium conductor of the same resistance and length as a given copper conductor will have an effective cross-section in the ratio of 100 to 60 = 1.666. The effective sectional area of an aluminium conductor is, therefore, 66.6 per cent. greater than that of a copper conductor of same length and resistance, and the diameter will be some 29 per cent. greater.

Weight.—The specific gravity of cast aluminium is about 2.60, but when drawn into wire, this is increased to 2.7t. As the specific gravity of copper wire is about 8.95, the relative weight of a given volume of each metal is in the ratio of 8.95 to 2.71 = 3.3. In other words, a copper wire of any given size and length will weigh 3.3 times as much as an aluminium wire of the same size and length. Aluminium, therefore, having a conductivity of 60 per cent. of that of copper, will have a sectional area 1.666 times as great as a copper conductor of the same resistance and length, and the ratio of the weights will be 3.3 to 1.666 = 1.98; that is to say, a copper conductor of any given resistance and length will weigh approximately twice as much as an aluminium conductor of the same resistance and length.

The weight of an aluminium conductor being only half that of equivalent copper, it follows that the cost of transport, erection, and handling will be proportionately less, and consequently, at anything under twice the price per lb. of copper, it will be more economical to employ aluminium.

Tensile Strength.—The tensile strength of aluminium depends largely upon the amount of work that is put upon it during its evolution from the billet or slab to the finished article. It is usual for extensive undertakings embodying long span construction, to draw wire having very much greater breaking loads, and this special material usually commands a slightly enhanced price. In stranding aluminium wire, it is not good practice to employ strands of a smaller size than 12 S.W.G., as the stresses are more evenly distributed in a cable of few layers. Use has been made in some quarters of a soft-drawn or hemp core, but neither practice is to be commended, the most satisfactory method being to strand in the usual way, feeding the core slack into the stranding machine, so that the outer layers take the major part of the pull.

Temperature-Resistance Coefficient.—The coefficient of increase of resistance with temperature varies somewhat with the extent and nature of the impurities present, and the temperature range over which it is taken, but is in all cases somewhat lower than for copper. Tests made on different samples of commercially pure aluminium give figures varying from between .32 and .39 per cent. per degree C. between 0 and 50° C. compared to .38 to .43 for copper.

Expansion Coefficient.—The coefficient of linear expansion being somewhat greater with aluminium than with copper, due allowance has to be made for this when installing.

The physical, mechanical and electrical properties of aluminium and copper are compared in the following table:—

Chemical symbol		Al.	Cu.
Atomic weight		27	63.2
Atomic volume		10.6	7.2
Position in electro-chemical series		10	24
Melting point, degrees Centigrade		625	1,060
Melting point, degrees Fahrenheit		1,150	1,940
Specific heat (water = 1)		0.212	0.094
Thermal conductivity (silver = 100)		31.3	73.6
Electric conductivity (silver = 100)		58.5	97.5
Coefficient of linear expansion per °C.		.0000234	.0000167
Coefficient of linear expansion per °F.		.0000130	.0000093
Specific gravity, cast		2.60	8.78
Specific gravity, rolled or drawn		2.71	8.95
Tensile strength in lbs. per sq. in.		20,000—30,000	40,000—60,000
Tensile strength in kgs per sq. mm.		15—20	30—40
Elastic limit as % of tensile strength		60%	65%
Modulus of elasticity in lbs per sq. in.		9,000,000	16,000,000
Modulus of elasticity in kgs. per sq. mm		6,330	11,200
Specific resistance in microhms	Soft	2.827	1.696
per cm. cu. at 60° F. (15.5° C.)	Hard	2.884	1.730
Specific resistance in microhms	Soft	2.667	1.582
per cm. cu. at 0° C. (32° F.)	Hard	2.768	1.614
Resistance of conductor 1,000 yds.	Soft	.04008	.02404
long by 1 sq. in. cross section	Hard	.04089	.02453
Coefficient of increase of	Per °C.	.0032—.004	.0038—.0043
resistance with temperature	Per °F.	.0018—.0022	.0021—.0024
Weight per 1,000 yds. by 1 sq. in. nominal section, lbs.		3,520	11,700
Weight per 100 ft. by 1 sq. in. nominal section, lbs.		117.3	392
Ratio of conductivities for equal area		.6	1.0
Ratio of areas for equal resistance		1.66	1.0
Ratio of diameters for equal resistance		1.29	1.0
Ratio of weights for equal area		1.0	3.3
Ratio of weights for equal resistance		1.0	2.0

High-Voltage Losses.—Referring to high tension losses the article says:—A very pronounced phenomenon of present-day high-tension transmission is the loss which takes place due to corona discharge. This is a subject which has received considerable study and it may now be said that its laws are fairly well understood. Briefly stated, the discharge occurs when the critical voltage is reached corresponding to the limiting steepness of the potential gradient for air. As is readily seen, a small conductor postulates a steep potential gradient and a correspondingly low critical voltage. If this critical pressure is lower than the line voltage, a glowing discharge will take place, and involve a serious loss from the line. The only means of keeping the striking voltage up to a safe value is by the use of the largest possible conductor. Here the advantages of aluminium are very pronounced, and as such have been widely recognised. Taking a concrete example, for a .06 sq. inch copper conductor with 10 feet spacing, corona commences at 86,000 volts, while with the aluminium equivalent this becomes 106,000 volts. If, therefore, the line pressure were 100,000 volts, there would be a loss on the copper conductors of about 3 kw. per mile of single circuit line, while on the aluminium lines no loss at all would take place. Stormy weather and high altitudes both reduce very considerably the corona voltage, and augment the losses.

A contract has recently been closed by the S. Morgan Smith Company for the supply to the Ottawa Electric Company of a pair of 48 in. "Smith" cylinder gate turbines of 1700 h.p. capacity, mounted on cast iron draft chest. These are to be placed in an open flume alongside two similar settings furnished by the same company about two years ago.

Homopolar Induction Machines

By Alexander M. Gray B.Sc.*

In the homopolar generator, a direct voltage is established between the terminals of the machine without the use of a commutator. Such a machine is shown diagrammatically in Fig. 1; the copper drum A cuts the uniform field produced by the exciting coil B and the induced electromotive-force established between the brushes a and b, due to the cutting of the field by the drum, is constant in magnitude and in direction.

One of the principal objections to this type of machine is that the voltage per drum is comparatively small; a drum 10 inches long, revolving with a peripheral speed of 10,000 feet per minute in a magnetic field having a flux density of 50,000 lines per square inch would have a difference of potential between the two ends of 10 volts. In order to generate 240 volts, such a machine would require 24 drums or conductors connected in series and would therefore require 48 slip rings each running at a surface speed of 10,000 feet per minute, and also 48 sets of brushes each carrying the full load current. In the homopolar machine then, although there is no commutation problem to be solved, there is the problem of designing a collecting device suitable for high rubbing velocities, a problem which is still giving a great deal of trouble.

Much time has been spent in the endeavour to design a homopolar machine which will not require sliding contacts, and the usual result of such wasted energy is a machine such as that shown diagrammatically in Fig. 2; the operation of this machine is based on one if not on two fallacies. If a direct current be passed round the exciting coil B, a magnetic field is produced as shown, and the assumption is made, which may or may not be correct but which has not been proven experimentally, that, as the rotor C revolves, the magnetic field revolves with it, and the lines of force cut the stationary conductor ab generating a voltage therein; it is also assumed that, since the conductor bc is brought out through a large opening and is therefore in a weak magnetic field, the lines of force will slide around the conductor in some way or other without cutting it, or, if they do cut the conductor, that the voltage induced therein will be very small because of the low flux density in the surrounding space.

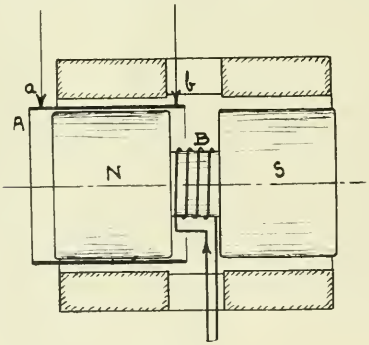


Fig. 1

That this latter assumption is wrong may be shown as follows:—In Fig. 3 a magnetic field as represented by lines of force, the lines passing through iron except at A, where they cross an air space; the flux density in the air space is much lower than in the iron. The direction of motion of the field relative to the iron and air space is shown by the arrow m. In a certain interval of time the line of force ab moves to a_1 b_1; the distance moved through in the iron is small, but that moved through in the air space is large, so that, while the flux density in the air space is low, the velocity of the lines of force in that space is large, and the same number of lines are cut by a conductor in the air space as by a conductor embedded in the iron.

In Fig. 2 the same total flux is cut by conductor bc as by conductor ab, and the voltages induced in these conductors are equal and opposite, so that the resultant voltage measured at the terminals ac is zero.

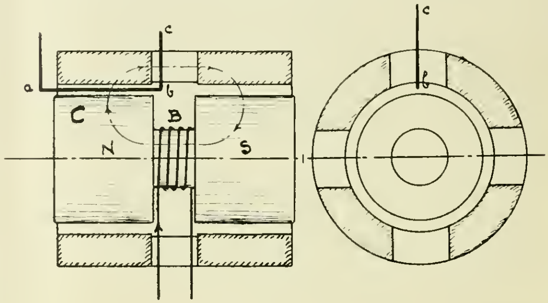


Fig. 2

In 1908 a paper was published by Carl Hering which showed that it was possible to have relative motion of a magnet and a coil of wire in such a way that the flux threading the coil could change and yet there would be no voltage induced in the coil; thus in Fig. 4, a loop L was formed of two flexible strips whose ends pressed together at the joint J, and the circuit of the loop was closed through a galvanometer G. On moving this loop over one leg of the U-shaped permanent magnet N S from the dotted position to that shown in full, an electromotive-force was induced, as is well understood. The magnetic flux has thereby been linked with the electric circuit; the flux enclosed by the circuit has been increased from zero to a maximum; or to use Faraday's terms, the lines of force in the air from one pole to the other, have been cut by the conductor.

If the loop be now moved as shown in Fig. 5 from the dotted position to the one shown in full, by passing the leg of the magnet through the joint J of the loop, but without opening the circuit, the flux and the circuit will be unlinked again; that is, the flux enclosed by the circuit will again be reduced from a maximum to zero, and the circuit will have cut the same lines of force in the opposite direction, as it is well known that all the flux of this magnet passes through its interior; but there is absolutely no electromotive-force induced by this unlinking.

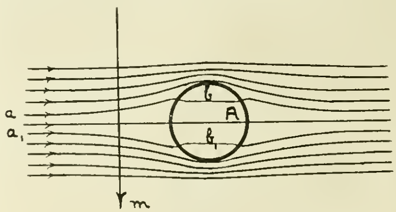


Fig. 3

After the publication of the above experiment the homopolar machine without brushes took a new lease of life and a machine such as that shown in Fig. 6 was proposed, the idea being that, if a revolving uniform field could be produced, this would cut the conductor ab and generate a voltage therein, but would not generate a voltage in the

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conductor represented by the iron jointing bc, because Hering's experiment, Fig. 5, seemed to show that, since it is possible to move the two contacts relative to the stationary field without getting an induced electromotive-force between the contacts, the converse should also hold namely, that it should be possible to move a magnetic field between two contact points and yet not have a voltage induced between these points. This type of homopolar machine will not give a voltage between terminals, the reason being shown later.

It was found that students had considerable difficulty in understanding these apparently conflicting results, and in order that they might have a definite conception of what is called homopolar induction, the piece of apparatus shown diagrammatically in Fig. 7 was built; its peculiar shape is due to the fact that it was made from pieces of scrap iron.

The iron core A is placed on the end of a motor shaft. The iron yoke D is stationary and carries the stationary exciting coil B. The copper drum C is carried on fibre discs so as to be insulated from the core A and can be rotated relative to that core by a belt operating on the pulley E. The three terminals a, b and c are connected to the three brushes d, e and f; the connection between c and f is a copper wire which is carried through and insulated from the shaft.

When current flows in the exciting coil a magnetic field is established which is represented by the lines of force

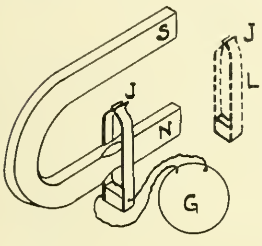


Fig. 4

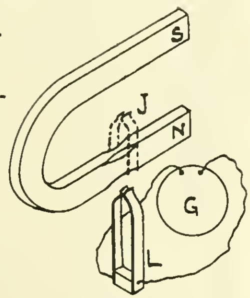


Fig. 5

ϕ_1 and ϕ_2, and if the core A be rotated, voltages will be induced in one or more of the conductors, ad, bd or ef.

Whether the magnetic field revolves with the core, or is stationary in space, has not yet been determined experimentally, but to the voltages which can be measured, namely, those from a to b, b to c, and c to a, it makes no difference which assumption is made, for example:—

Let the core A revolve in the clockwise direction and the copper drum C revolve with the core, then, assuming that the magnetic field is stationary in space,

the difference of potential between d and a $= 0$.

between d and b $=$ a const $\times (\phi_1)$

between d and c $=$ a const. $\times (\phi_1 + \phi_2)$

and the voltage between a and b $=$ a const. $\times (\phi_1)$

between a and c $=$ a const. $\times (\phi_1 + \phi_2)$

between b and c $=$ a const. $\times (\phi_2)$

If on the other hand the assumption is made that the magnetic field revolves with the core A then,

the difference of potential between d and a $=$ a const. $\times (\phi_1 + \phi_2)$

between d and b $=$ a const. $\times (\phi_2)$

between d and c $= 0$.

and the voltage between a and b $=$ a const. $\times (\phi_1)$

between a and c $=$ a const. $\times (\phi_1 + \phi_2)$

between b and c $=$ a const. $\times (\phi_2)$

that is to say, the readings that can be taken give no indication as to whether or not the field revolves, but they do show that the conductor ef cuts the total flux $\phi_1 + \phi_2$ during each revolution, even although the flux density in the air space around this conductor is much lower than in the adjoining iron.

An interesting modification of the above experiment is obtained by removing the conductor ef, placing brushes at g and h and connecting them to terminals m and n, as shown in Fig. 8. It would seem at first glance that the line joining the brushes g and h is a conductor which is stationary when

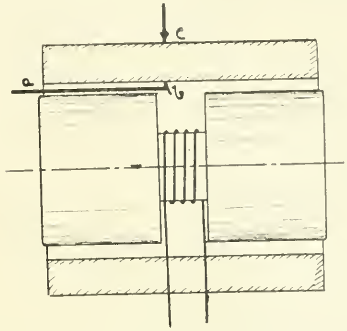


Fig. 6

brush g is stationary and which revolves in the same direction as brush g when that brush revolves.

That this assumption is false was seen from the results, which showed that, no matter whether the brush g was stationary, was revolved in the same direction as the core A or in the opposite direction, the same voltage was obtained in each case between the terminals m and n, and that this voltage was the same as that obtained between a and c in the first experiment, that is to say, the iron between f and g is a conductor which moves in the same direction as the core, no matter how the brushes are moved.

If the above interpretation of a conductor be applied to Hering's experiment, Fig. 5, then his results are readily explained, because when the coil and brushes are moved but the magnet is stationary then the conductor is stationary and does not cut the flux, while if the magnet be moved and the coil and brushes are stationary then the conductor moves

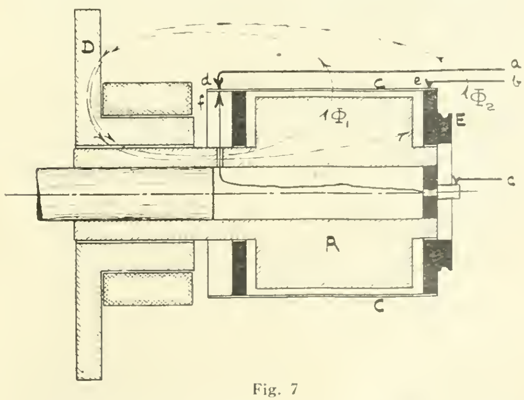


Fig. 7

with the magnet, at the same rate and in the same direction as the magnetic flux, and again there is no cutting; the voltage between the brushes is therefore zero in each case.

Many other experiments on homopolar induction may be performed with this piece of apparatus, but enough has been mentioned to show that it is a valuable addition to the equipment of an electrical engineering laboratory.

In conclusion the writer wishes to emphasize the remarks of Carl Hering who, in showing that the law of electromagnetic induction is not stated in such a way as to be readily understood by students, because it is generally stated that the generated electromotive-force in a coil is proportional to the rate of change of flux in that coil, a law which it is difficult to apply to the cases mentioned in this article, says that, in addition to Faraday's statement that "if a con-

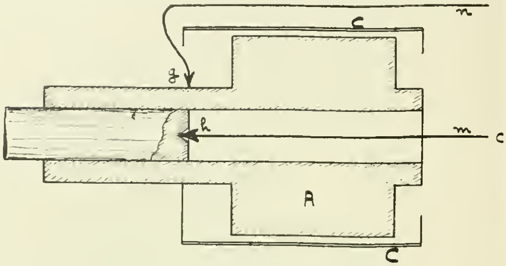


Fig. 8

ductor cuts magnetic lines of force an electromotive-force is generated," it should be emphasized that the conductor implies the material thing itself when distinguished from a theoretical line representing the closed circuit or current path.

Montreal and Quebec Activities

In the absence of Mr. J. E. Aldred, president, who is in Europe, Mr. Thomas McDougall occupied the chair at the annual meeting of the Shawinigan Water and Power Company, held in Montreal, on January 18th. The report showed:—

	1912	1911
Gross earnings...	$1,569,671	$1,219,857
Expenses	207,414	160,452
Interest	489,896	436,750
Net revenue	872,360	752,512

Dividend disbursements for the year accounted for $540,000; the sum of $189,375 was transferred to reserve and sinking funds; $25,000 to contingent fund; $103,475 to depreciation reserve, and $24,281 was carried forward to surplus. The gross earnings of the company from all sources increased $349,814, and the net revenue for the year $119,619. By the issuance of $1,000,000 of new stock in October, 1912, at $120 per share, there was realized $1,200,000. The premium on this was carried direct to reserve fund. The directors draw attention to the present condition of the reserve and sinking funds:

In 1908 these aggregated funds stood at ..	$190,000
In 1909 these aggregated funds stood at ...	252,500
In 1910 these aggregated funds stood at ...	342,575
In 1911 these aggregated funds stood at ...	600,000
In 1912 these aggregated funds stood at ...	$1,000,000

The average percentage of operation and general expense to gross income has been, for the past five years, on a basis of 10½ per cent. The ratio for the year 1912 is 9.45 per cent. In the last annual report the Directors advised of the completion of the new development with machinery installed in station No. 2 up to a capacity of 30,000 h.p. In August last it was decided to install a third unit of 15,000 h.p., and this installation is nearing completion. With this unit the total electrical capacity of the two stations will be 100,000 h.p.

The directors also state that the continued demand for power makes it evident that this addition to the plant of the company will be required for use at an early date. As an evidence of the growth of the demand in the last five years it may be noticed that while the total electrical load on the power house (apart from the hydraulic power sold) in January, 1908, was slightly over 30,000 h.p., the beginning of 1913 shows a total demand of over 62,000 h.p. with peaks carrying the total load at times to 80,000 h.p.

The rapid industrial development of the city of Three Rivers makes it expedient to provide for further demands from that point, and the directors have in contemplation, in the spring of 1913, the erection of a third transmission line to Three Rivers. This line will be of steel tower construction with two circuits. The industrial growth at this point is shown by the increase in the electrical load. While in 1908 the sales of power by this company in Three Rivers had not yet commenced, in the present year the electrical load has reached over 12,000 h.p., which will be further increased during the year.

The following executive officers and directors were re-elected:—J. E. Aldred, president; Thomas McDougall, vice-president; Howard Murray, treasurer; W. S. Hart, secretary; Julian C. Smith, chief engineer and general superintendent; directors, R. M. Aitken, London; H. S. Holt, Montreal; John Joyce, Boston; Sir William Mackenzie, Toronto; Sir M. Mitchell-Thompson, Bart., Edinburgh; Denis Murphy, Ottawa; W. R. Warren, New York; E. R. Wood, Toronto.

Montreal Tramways Co.

Mr. R. M. Hannaford, acting chief engineer of the Montreal Tramways Company, lectured before the Canadian Railway Club, Montreal, on "Electric Railway Construction." The lecture was chiefly of a popular character, Mr. Hannaford outlining the history of the company and speaking of the difficulties in track laying. He remarked that in 1863, two years after the incorporation of the Montreal Street Railway, the company carried 1,066,845 passengers as compared with 139,406,295 in 1912. The company had received its charter on May 18th, 1861, to operate in the city and parish of Montreal, and awarded its first contract for building and operating the first section of the road on August 17th. This section consisted of six miles of single track, with an equipment of eight passenger cars. Four years ago, when the company was re-laying tracks on St. Catherine street, the workmen came upon some of the original ties, submerged nearly three feet beneath the pavement, which showed that the street had been raised that much in recent years. The people who found time to complain about the workings of a street railway did not know the difficulty met with in constructing lines. The people who would complain of service were the same who complained of the company leaving their equipment and excavation near their premises when laying new tracks or repairing old ones.

In referring to track laying, Mr. Hannaford stated that in a city, like Montreal, where the streets were narrow, and the larger cars were used, it was impossible to construct curves sufficient to permit the passing of two cars around inside and outside curves at the same time. Thus one car had to remain standing until the other rounded the curve, and this, he stated, accounted to a great extent for the congestion so much complained of. Mr. Hannaford also commented on the expense of cleaning the streets in winter. In the early days of the company, it had been claimed impossible to keep the roads open all the year round, and therefore, the winter traffic had to be carried in sleighs. Public opinion then ran strongly towards the contention that the first snowstorm would block the railway for the winter, while to-day, by the precautions taken, the tracks were kept clean. Records showed that between the years 1875 and 1891, the snowfall had been 118 inches; between the years 1891 and 1912, it had been 117 inches; the least snowfall was 7 inches.

in 1894, while up to January 31st of this year, 50.4 inches had fallen, which was one inch more than had fallen up to the same period last year.

Electrical Association of Province of Quebec

Most of the discussion at the annual meeting of the Electrical Association of the Province of Quebec, held in Montreal, concerned the future of the society. Mr. Clarence Thomson presided. Mr. L. E. Simoneau raised the question as to the compulsory licensing of contractors and wiremen, and instanced a case where he had been asked to quote on a small job; after giving his price he was informed that a wireman would do the work for a third of the amount he had quoted, the wireman working at night; no doubt this man would be able to get the underwriters' certificate, and the association ought to be able to stop this unfair competition. Mr. Ellis suggested that the association might amalgamate with the Sons of Jove. Mr. Shaw remarked that the contractors apparently did not care to join the association. Mr. N. Simoneau was in favor of continuing the association, as there was plenty of room for it. In reply to a suggestion by Mr. McLaughlin that the contractors should be canvassed, the chairman said that this had been done, but not with great success. Mr. McGregor was of opinion that the new officers might see if they could infuse more vitality into the association. Mr. Shaw stated that the Sons of Jove were about to consider the question of compulsory licensing, and said that the associations might work together on this matter. Mr. St. Amour said that, if the association could not increase its membership within the next twelve months, they might amalgamate with the Sons of Jove. The following officers were elected: Hon. president, Mr. Clarence Thomson; president, Mr. L. Rousseau; vice-president, Mr. C .E. McGregor; hon. secretary-treasurer, Mr. S. W. Smith; executive committee, Messrs. N. Simoneau, E. W. Sayer, C. P. Ellis, J. A. Valois, and J. A. St. Amour.

Valuable Islands

Judgment has been given in a long drawn out legal fight between the Cedars Rapids Manufacturing & Power Company and the estate de Beaujeu concerning three islands in the St. Lawrence which the company desire to utilize for their power scheme. The tender of the company for two islands was $4,200—$2,500 for Isle aux Vaches, and $1,700 for Isle au Point. The Superior Court award for these islands was $80,000 and $62,000 respectively. The tender of the company had been approved by a board of arbitrators, but the estate de Beaujeu took the matter to appeal before the Superior Court. The judgment handed down by Mr. Justice Davidson is a vindication of the rights of riparian proprietors to the power possibilities of the waters fronting their holdings, the tenders of the company made in the first instance representing the actual intrinsic value of the land considered apart from contiguous water power possibilities. An action entered against a tender of $200 made by the company for Isle Bedard was maintained by the Court, but the question of this island is to be re-opened, the estate claiming $34,000 for the property.

Will Report on Underground Plans

The controllers of the city have been requested to study the question of the city constructing a system of underground tramways. The motion asks that the controllers make an exhaustive inquiry into the question of "determining the most acceptable means of (a) relieving the congestion and the overcrowding of travel in the city, as well as (b) devising a scheme to meet all the future requirements of the public, commensurate with the ever-growing expansion and development of Montreal. That the Board of Commissioners, in their consideration of this all important question, be requested to carefully examine and report upon the establishment of a subway service, similar to that in existence in several larger European and American cities, said service to run north and south, and east and west, by means of double or more tracks. That the Board also consider the advisability of the city undertaking the construction of said proposed subways and leasing the same to an operating company at a rental which would enable the city to meet interest charges and sinking funds, in order that the loan, made in this connection, might atuomatically be paid off at its maturity.", The report of the committee of aldermen on reducing the number of street car stops was likewise sent to the controllers, so that the board and the council may act together.

A Jovian Club

The Montreal members of the Sons of Jove have decided to establish a club, and secure headquarters for all those interested in the electrical industry. This was decided on at a meeting held under the presidency of Mr James Bennett, the statesman. The following officers were elected: President, Mr. James Bennett; vice-president, Mr D. H. Ross; secretary, Mr. A. M. Muirhead; treasurer, Mr. Watson Jack; auditors, Mr. Gordon C. Bowie and F. W. Wiggins. Executive committee: Messrs. W. R. Shaw, chairman; W. J. Doherty, P. T. Davies, James Bennett, D. H Ross. Membership committee, W. M. Turnley, chairman; A. J. Carroll, C. B. Ellis. Other committees appointed were: Finance, Mr. W. P. Baird, chairman; House, Mr. F. J. Parsons, chairman; Publicity, Mr A. J. Johnson, chairman.

St. Catharine Street Conduits

The Public Utilities Commission on February 20th had before them the plans of the Montreal Electrical Commission for constructiong underground conduits on St. Catherine street. Objections were heard, but the various companies ultimately agreed upon the plans, and these will be signed by the Commissioners when the alterations agreed upon are made. Dr. Herdt, the chairman of the Electrical Commission, in reply to a question as to what provision had been made in laying the conduits for additional companies coming in, stated that there would be enough room to lay wires which would give another company the same capacity as that of the present companies.

Lease for 75 years

It is officially announced by the Hon. Jules Allard, Minister of Crown Lands of the Province of Quebec, that the Government have decided not to sell any more water power but will lease the water powers for 75 years. They will allow twenty years to readjust the royalties and there will be a royalty for every horse power generated. Moreover, if the companies have any surplus, the Government will compel them to sell the power to local users first at a reasonable rate, and if there is any dispute as to price, it will be settled by the Public Utilities Commission.

The directors of the Shawinigan Water & Power Company have decided to add two units to the plant at Shawinigan Falls, making five altogether. The water wheels will be supplied by the I. P. Morris Company, of Philadelphia, and the generators, of 15,000 kv.a capacity, by the Canadian Westinghouse Company.

The addition to the No. 1 elevator of the Montreal Harbour Commissioners will involve the practical reconstruction of the electrical plant Some of this will be removed, and additions will be made which will increase the power required

Pacific Province Progress

Under the heading "Public Utilities," the following statement occurs in the report for 1912 issued by Mr. F. L. Fellowes, city engineer of Vancouver:

The year 1912 marks the commencement of the Western Canada Power Company's operations within the city limits, and since construction was started a vigorous policy of extension has been adopted. To date 18.65 miles of underground cable have been laid in 11.09 miles of trench, approval having been granted for 36.19 miles of underground cable. All the overhead work has now been constructed, representing a total of 6.45 miles. A very commendable feature of this company's operations is the underground construction that has been adopted throughout the business sections of the city, and it is unfortunate that other companies operating pole lines in these sections cannot be compelled to do the same. With the advent of another company seeking a franchise for steam heat, refrigerator, light and power mains under city streets and lanes, it is becoming imperative that some well defined system be adopted as to location and depth of all underground construction, and any new franchise granted should stipulate explicitly that the method or manner of installing all or any part of such systems must be to the specifications and approval of the city engineer, and in such locations and depth as may be directed by him.

I would recommend that the question of underground construction be taken seriously in hand at once, and an assistant engineer appointed to this branch of the department, to devote his whole time to looking after public utility matters so that a comprehensive scheme can be drawn up covering the exact location and depth of all future ground work. From now on this class of construction is bound to increase rapidly, and it is very necessary to conserve every available inch of space in street and lane allowances, and unless each company has a given location and depth to adhere to, the line of least resistance is invariably taken, which means underground work running in all directions and, in consequence a serious loss of space. I consider this question of underground construction one of the greatest importance. By taking this matter in hand now an untold saving can be effected to the city in later years.

Will Build Twenty Miles This Year

Mr. Wm. McNeil, assistant general manager of the Western Canada Power Company, and chairman of the Burrard, Westminster, Boundary Railway & Navigation Co., Ltd., Vancouver, announced recently that work will be commenced this year on the installation of two additional electrical units at the former company's plant at Stave River Falls, situated about 35 miles east of the city of Vancouver. It is intended to complete the work in about eighteen months. The present installation of two generating units has a normal capacity of 25,000 horse power, and will carry continuously, if required, a 25 per cent. overload. With the installation of the additional electrical units, the company will thus have 50,000 horse power available for distribution. The total possible development at Stave River Falls will then have been completed, but the company will probably later duplicate its plant and output at a point three miles below the falls on Stave River, where the channel narrows and the waters rush through a contracted canyon—an excellent site for power purposes.

The increasing demand for power in the districts served by the company, including the large field in the city of Vancouver, is responsible for the determination to commence work at an early date on the extension of the plant. It is stated that the additional units will be in operatior by the time it is necessary for the company to supply power for the operation of the Burrard, Westminster, Boundary Railway & Navigation Company's line between Vancouver and Mission City, along the north bank of the Fraser River. About twenty miles of this line will be built this year, between Stave River Falls and the Pitt River. The work will be started in May, and within two years the entire line of railway between Vancouver and Mission City will be completed. For twelve miles eastward from Stave Falls, the railway will follow the general line of the Dewdney trunk road, thence westerly it will take a more direct route to the Pitt River than is followed by the road. The Burrard, Westminster, Boundary Railway & Navigation Company recently concluded contracts for the transportation of an immense quantity of logs from lands in the vicinity of Stave River, and Stave Lake. The owners of the timber tracts are anxious to commence logging operations on a large scale at an early date, and in order that the movement of the logs may be commenced as soon as possible, steam locomotives will be operated on the road as soon as the rails are laid. Eventually, of course, the railway is to be an electric one, drawing its power from the Stave Falls plant of the Western Canada Power Company. The railway Company will commence electrification of the line as soon as the roadbed has been completed, but it is estimated that two years will elapse before electricity will be the sole motive power in use over the entire stretch between Vancouver and Mission City.

Hon. Thos. Taylor, provincial minister of public works, has announced that work on the construction of the railway and traffic bridge over the Pitt River will be commenced early this summer. This bridge will be used by the railway company, and will be completed by the government in two years' time from date. The railway will cover the rich agricultural district along the north bank of the Fraser River, all of which will eventually become tributary to the Vancouver market.

Full Capacity at Jordan River

During the second week in February the Jordan River plant of the Vancouver Island Power Company was again in operation to its full capacity of 12,000 horse power, the repairs to the generating units which were damaged by lightning last November, having been successfully completed. One of the units was repaired within two weeks of the accident, giving 6,000 horse power, and with the Brentwood Bay and Goldstream power plants in full running order, the company were enabled to generate a sufficient supply of power, though the capacity was taxed to the utmost. The repairs to the second unit were of a more complicated nature, the assistance of the company's experts in Vancouver being found necessary.

The installation of a third unit at the Jordan River plant is now under way, and its power will be available next fall. The addition necessitates the expending of a large sum on enlarging the storage facilities and the pressure line at the power station, and in additions to the present plant, but at the rate at which the demand for power for all purposes has increased in the city of Victoria and adjoining territory, the additional supply will be fully utilized. Since the Jordon River plant was installed, more than one year ago, the company's output of power has increased by more than three hundred per cent.

Good Year for Nelson, B.C.

The city of Nelson according to the annual report of Mr. Herbert P. Thomas, city electrical engineer, has had a very successful year in their light and power department. The revenue has exceeded $62,000 and the actual expenditure, including some $23,000 on capital account, has been about $45,000. The street lighting of the city has been improved

by the installation of twenty-four 3-light tungsten standards, ten 4-light clusters and ten carbon lamp clusters. The number of consumers now on the city books is 1,414, an increase of 138 over 1911. During the past year the power load was increased by 85 h.p. making a total connected load of 998 h.p. at the present time.

Until a short time ago all lighting in Nelson was sold on a flat rate, but owing to the fact that consumers did not take the trouble to turn their lamps out even during the day time, it was decided to install meters, and 379 are now in service, including power meters. The difference in load is shown by the fact that the average maximum load carried by the generators during December, 1911, was 1320 h.p., while for December, 1912, with the meters installed and with the added consumers as above noted, the average maximum load was only 1,145 h.p., a decrease of 175 h.p.

The plant from which Nelson derives its light and power is municipally owned. It is a hydro-electric system at Bonnington Falls a few miles out of the city.

Cluster Lighting in Victoria, B.C.

According to the recently issued annual report of City Electrician Hutchinson, of Victoria, the cluster lighting system in that city now covers about eight miles of the downtown section, equipped at a cost of $250,000. In his report the city electrician refers to the policy approved of by the last council for extensions of the cluster lighting system to the residential sections, the owners benefitted to be required to pay for power as well as the differences between the cost of the existing arc lighting system and the cluster lighting system, and recommends that this policy be continued. The arc street lighting system has also been improved by the installation of more lights and a re-arrangement of the main circuits from the power station to James Bay, the Fairfield section, Victoria West, and Spring Ridge, in which districts the growth of the city has been pronounced. Reference is made to the benefit derived by the city from the low rate for power obtained from the Jordan River plant of the Vancouver Island Power Company, and the installation of additional machinery at the city plant to provide for the utilization of this power. The city electrician closes his report by recommending that this year, additional storage room for equipment be provided, together with a motor service truck and the continuation of the work of laying underground conduits to provide for the cable when it is required.

New Sub-Station for Victoria

The British Columbia Electric Railway Company will shortly commence the erection of a power sub-station on Richmond Road in the Oak Bay district, Victoria. The cost of the new station, including the site, is estimated at approximately $40,000. The settlement of that portion of the city and the adjacent municipalities has rendered the sub-station imperative as to serve that section at present, means the erection of more pole lines, and the addition of a great amount of equipment which encroaches upon the streets between the Store street station and the eastern section. By the erection of the sub-station on Richmond Road, the power lines of sufficient capacity to meet future requirements can be laid in such a manner as to be least inconvenient to the public, and the supply for that section concentrated at the station whence the lines can reach out as required. A more efficient and safer service will thus be given

The Coquahalla Development

The Hope & District Power, Light & General Development Company, Limited, recently applied for the use of water from the Coquahalla River for power purposes. This river flows in a westerly direction through the Coquahalla Canyon and empties into the Fraser River near Hope. The amount of water for the use of which application has been made is estimated to develop 8,000 horse power. The plans of the company are only partially known at present, but they include the installation of an electric lighting plant for the town of Hope, B.C. Attention has been drawn many times within the last two years to the splendid asset in the water power of the Coquahalla River, which has been so long neglected, and the development of which may mean so much to the town and district. The president of the new company is Mr. A. E. Raab, and his associates include among others Mr. H. V. Dardier, president of the Anfeas Gold Mines, Ltd.

Vancouver Street Lighting

Following is a statement showing the number of extensions made to the street lighting system at Vancouver during 1912:—

Street arc lamps.—The total number of arc lamps in the city at the end of 1912 was 1,669; an addition of 248 lamps since the end of 1911.

Ornamental street lighting.—The total number of ornamental cluster light standards in use at the end of 1912 was 621; of this number 352 were installed during 1912. Ornamental cluster light standards are now installed at the following locations: Granville street, 125; Hastings street, 126; Main street, 88; Pender street, 90; Cordova street, 78; Robson street, 66; Beach avenue, 48; total 621. The following ornamental cluster light standards are under construction. Harris street, 76; Hastings street, 44; Granville street, 40; Main street, 59; total 219

Contract is Closed

Mr. C. H. Cahan, K.C., president of the Western Canada Power Company, has just returned to Montreal from England, where he has been in negotiation with the directors of the British Columbia Electric Railway Company for the supply of power. A meeting of the directors was held in Montreal, on February 18th, and at its close Mr Cahan announced that a contract had been made with the B. C. E. R. Company for the sale of a large quantity of electric power to that company on satisfactory terms. The contract commences with a supply of 12,000 horse-power on September 1st next, increasing to a maximum supply of about 40,000 horse-power upon the completion of the Western Canada Power Company's second installation.

New Terminal for B. C. E. R. Co.

The B. C. Electric Railway Company have bought the northeast corner of Pandora avenue and Douglas street, Victoria, B.C., for their new terminals. It is the intention of the company to erect, at an early date, a ten-storey building to house the various departments of the company. The location is in the very heart of the city and splendidly adapted for the company's requirements. In rear of the office building the terminal station for the Saanich and Suburban System will be erected. The cars will reach the building from Douglas street, via Cormorant street, on three tracks, running through the station to Pandora avenue.

Kalso Lighting Contract

The city of Kaslo, B.C., is making a determined effort to secure better terms in its lighting contract with the Kootenay Electric Light Company, and it is said that if negotiations with the company prove unsatisfactory, the city may assume the ownership of its lighting plant. A communication was addressed to the light company recently in which it was pointed out that though the city were buying 4,500 watts at a monthly rate of $97.10, they were willing to pay the same amount for 3,500 watts flowing through tungsten lamps, according to a plan attached to the letter.

Recent Telephone Extensions

To secure the utmost efficiency when the new cable is laid to Vancouver Island, between Point Grey and Nanaimo, the B. C. Telephone Company has decided to run a line up the Saanich Peninsula, using a two-mile submarine cable under Saanich Inlet, and another aerial line between Cobble Hill and Nanaimo. Expenditure on this may run as high as $20,000. A party of B. C. Telephone officials, consisting of Messrs. G. H. Halse, secretary-treasurer; C. F. Bollschweiler, general superintendent of plant; G. McCartney, superintendent of construction, and E. P. Labelle, plant engineer, went over the route early in January, and located a suitable landing place for the cable on the peninsula side of the Inlet. The cable will be 10-pair, 13-gauge, lead covered and armored, two miles in length. The company's line now runs over the Sooke Mountain, but there is danger from interruption on this route owing to the timber and snow. On the other route these dangers practically do not threaten. The line now in use will be maintained as an emergency. While on the trip up the Saanich Peninsula, much development was apparent. This district is going ahead rapidly, and expansion there will be materially assisted by the construction of the tram line by the British Columbia Electric Railway Company. After looking over the Peninsula the party went to Cobble Hill and though no records or maps were obtainable, a good route was selected for the line between that point and the inlet, a distance of three miles.

New Telephone Buildings

Progress is reported by the building department regarding the final plans for the new offices and stores to be erected by the B. C. Telephone Company on Front street, Vancouver. These are now ready, and if approved, work will be started at once so that the building will be ready for occupancy early in the summer. Construction of the new school, adjoining the Fairmont exchange, is proceeding rapidly. The brick walls are all up ready for the roof, and the steel work is in position. It is expected that outside construction will be practically completed about the middle of the present month, and the plastering will be finished the first week in March. Amended plans for the new telephone office on Ferris Road, South Vancouver, are now awaiting approval. This office will be up-to-date in every respect, and will enable the company to take care of that district for some time. The new office at Alberni was completed and ready for the switchboard on January 15th.

Plans are now being prepared for a new head office building for the company, to be erected on Seymour street, Vancouver. The building is to be ten storeys high, and will represent an investment of nearly half a million dollars when equipped. It will house the Seymour exchange, and the present buildings, now badly crowded, will be given over to other purposes. It is expected that the new structure will be ready for occupancy about the beginning of 1914.

Small Towns Well Equipped

Improvements in service made by the B. C. Telephone Company are not confined to the cities and larger towns. During the past few months work has been extensive on the lower mainland and Vancouver Island particularly. Much work has been carried out in Vancouver, North Vancouver, New Westminster, Victoria, Nanaimo and Alberni. To secure the fullest advantage of the increased facilities, new circuits have been strung and new equipment installed throughout the Fraser River and Burrard Inlet districts. The new circuits include two to Ladner, two to Milner, one to Cloverdale, a line to Abbotsford, a new cable across the Pitt River and a new cable to Mission Junction. In practically every one of the smaller exchanges improvements have been made in the way of switchboards. These have been installed at Ladner, Trail, Sydney and Phoenix.

Issuing More Bonds

The Bell Telephone Company propose issuing additional bonds and debentures to the amount of $3,750,000. The outstanding bonds of the company at present amount to $6,399,000 and the paid-up capital to $15,000,000. The company have authority to issue bonds up to 75 per cent. of the paid-up capital. The company will add two and a half storeys to their present head office on Hospital street, Montreal, making eight and a half storeys in all. The work is estimated to cost $52,000. The addition will be constructed of brick, and the floors of maple. The roof is to be felt and gravel. Mr. W. J. Carmichael is the architect.

Alberta's Telephones

The telephone department of the provincial government of Alberta has just issued a report showing a net profit for the past year of $62,283, and a total net profit for the past six years during which the system has been operated by the province of $407,592. Since the province took over the telephone system it has grown from 1,859 wire miles connecting 70 offices to 6,698 miles connecting 234 offices.

3,600 Ft. Cable

The Segur Oil Refineries is laying a cable 3,600 feet long from Barnet to its barrel manufacturing plant on the north side of Burrard Inlet. The object is to establish telephone communication. Residents of the vicinity will have the advantage of connecting with the cable.

Running Waters in Quebec Prov.

By a recent Act of the Quebec legislature, a commission was appointed for the management of running waters in Quebec, consisting of three commissioners who are experts in hydrography and the management of forests. The committee has since occupied itself with the preparation of a report on the regulation of the waters of the St. Maurice River by the construction of storage dams, and has now issued a report to the legislature under date November, 1912, copy of which is just to hand. The members of the commission are S. N. Parent, chairman; Ernest Belanger, and Wm. I. Bishop. The following extracts with reference to the water resources of the Province of Quebec and to the general value of regulation by means of storage reservoirs are of more than ordinary interest.

Water Resources

The Province of Quebec is particularly well favored from the standpoint of water-powers. On the strength of calculations made under its direction, the Conservation Commission of Canada estimates the total available powers in our province at 6,000,000 horse-power. We think this estimate is far too low and nobody who knows the situation will be astonished at this because on many occasions there has been found a total lack of accurate official data on the subject, while those that exist are insufficient.

In its report for 1911 the Conservation Commission of Canada gives the total amount of power developed in this

province at 300,153 horse-power. The total power developed at this date can be estimated, without any exaggeration, at 400,000 h.p., taking into account inaccuracies in data available, and later developments. But above all our province should be given its due share of the power developed on the Ottawa River, owing to the latter's geographical position, which comes as an addition to the first figures mentioned. This enormous power represents a very considerable asset which cannot but increase in value as the years go by.

The era of White Coal may be said to be merely at its inception in our country. This is an economic fact the far-reaching consequences whereof can already be seen. Legislators cannot therefore be indifferent on the subject. It is exceedingly important to prepare for the new conditions that will result. The advance of progress is more rapid and is surer when the ways have been foreseen and prepared. The government has fully realized that it is necessary to lay the foundation of a broad and farseeing policy of conservation. By this is meant, with regard to natural resources, not only their protection, but also their judicious utilization in the public interest, one as well as the other.

Such tremendous strides have been made, within the past ten years, in the development of hydro-electric power and its transmission that its field of action has been increased tenfold. And the day is beyond a doubt not very distant when water-powers now deemed practically inaccessible, will come into demand to be used.

New electro-chemical and electro-metallurgic processes are constantly being brought to light and their commercial application calls for ever increasing amounts of power. The pulp and paper industry, which as everybody knows, is one of the largest power consumers, is constantly increasing its demand for power.

Taking all these facts into account, it clearly appears that our province, however great may be the wealth of its hydraulic resources, must not only exercise the greatest care and be sparing of such resources, but must also seek to improve those already developed in order to obtain the greatest possible benefit from them.

Control of Stream Flow. Its Necessity

In the majority of the rivers of Quebec, there is an enormous variation between the maximum and minimum flow under ordinary conditions. Let us consider the result of such fluctuations. Under certain given conditions when a regular flow throughout the year would give 8,000 horse-power continuously, the result of these considerable variations under ordinary natural circumstances, is that the real capacity drops to 2,000 hores-power. On the other hand, at high water, it reaches 200,000 horse-power, but only for short periods. During our long and cold winters the usual sources from which our rivers are fed, are dried up by frost. Hence the flow is lessened to a degree equalled only, under precisely opposite conditions, in semi-tropical countries where heat and drought cause the waters to be at their lowest in summer.

In our case, water is at its lowest about the middle of winter. All that season also, the water at the foot of falls and cascades wherever it is smooth, becomes filled to a considerable extent with crushed ice (frazil) or anchor ice, causing very serious drawbacks, in many instances complete stoppage of the works. Such drawbacks would be avoided if the flow of water were increased so that a portion of it could be used to force away that ice. But, under present conditions, the period of extreme low water occurs precisely in winter, where a sufficient volume of water is not usually available to allow of the necessary quantity being withdrawn without completely stopping the works. Such irregularity in the flow of our rivers is thus practically general. There is, however, a brilliant exception in the case of our incomparable River St. Lawrence. The proportion of the maximum to the minimum flow is in fact two to one. It should be observed, however, that its course is practically the most stable of all the rivers of the world.

Deforestation and Stream Flow

Some claim that excessive deforestation has no prejudicial effect on the conditions of our rivers. This opinion is shared by a certain number of authorities on the subject. It would seem, however, that in any case the preponderant majority holds a contrary opinion. It seems beyond a doubt, and a fact fully proved by experience, that the action of the forest has a very marked effect as regards freshets, the regulation of the flow and the conditions of rivers. But the effects of deforestation are greater in mountainous regions. As a general rule, however, it is admitted that deforestation to a considerable extent at the sources of streams causes rain or surface water to run off more rapidly, increasing freshets and making them more damaging, and produces a greater corresponding decrease in the flow at the low water stage than would occur under natural conditions.

In any case, an interesting fact may be noted here. It has been found that, in some rivers on the north shore of the St. Lawrence where there has been little or no deforestation, the flow is not exempt from variations. Thus it will fall as low as ¼, i.e., 0.25 cubic foot per second per square mile of the water basin and rise to eighty times that volume at high water. This has been noticed on the Malbaie River. It is evident, therefore, that the necessity of regulating the flow is ever present even under conditions which theoretically seem the best.

Possibilities of Water Storage

The great irregularity in the flow of rivers from whatever cause, is therefore an established phenomenon. But there is also a means of remedying it. Nature has provided for it by enabling us to hold back the highest or surplus water which through lack of proper distribution, is lost in the sea. Such holding back of the waters is effected by means of storage dams and the operation is also known by the name of storage. Here again our province is exceptionally favored through its physical conformation.

The Laurentian watershed north of the St. Lawrence, may be said to present an uninterrupted series of lakes, the distinguishing features whereof are rocky and steep shores and narrow outlets. Such are precisely the conditions required for making storage dams and for holding back the water at a comparatively small expense. It seems, therefore, therefore, that, with very few exceptions, the rivers of the Province of Quebec offer great facilities for regulating works which would assure the stability of their flow and make it practically equal at all seasons of the year.

Flood Prevention

River flow regulation by means of storage dams would put an end to the devastating floods which occur periodically in the valleys of our rivers, damaging highways, railways, bridges and other works or structures, and doing no less harm to farming lands through erosion of the soil and the layers of silt and sand deposited on them.

Lumbering Industry

This industry will also directly benefit by the elimination of excessive freshets; when these occur, the booms are broken, causing very heavy losses of timber. With a regulated flow such accidents would no longer be feared. Moreover, the log driving could begin earlier and be carried on later in the season. At the same time the logs would not be held back by grounding on the sand bars and banks, as now happens every season when the level of the water falls.

Water Powers

We have seen that, owing to the excessive variations between the levels of high and low water, there are very

considerable differences in the capacity of such powers. By increasing the minimum flow their available capacity would become several times greater and would remain so permanently. As to the powers already utilized, it will readily be seen that the direct benefits of such increase would attain a high figure. Future enterprises could be organized in such manner as to benefit by the greatest minimum flow which would be assured. The province would be the first to benefit by it directly through the increased revenue it would derive from water-power concessions and indirectly afterwards through the growth in population resulting from the creation of extensive industries. There are a great many small rivers whose present flow at low water is too weak to make it worth while attempting to utilize their water-powers. Such flow at low water might, however, be increased sufficiently for the establishment of works on a profitable footing. Moreover, the effect of regulating the flow would be to lower the figure of the unit on which one usually relies for utilizing water-powers, the capital or initial cost of the undertaking.

Thus, the same works, dams, etc., required for utilizing a stream with its present minimum flow and corresponding power, or even works on a smaller scale would suffice to produce several times such minimum power with a stream whose flow would be even, that is, regulated. Let us take an instance. We will suppose that a dam is to be erected on a river of sufficient strength to resist exceedingly high freshets, and that its cost would be about $50,000. If the capacity produced with the present weak flow is 2,000 horse-power, the expense of making the dam would therefore be $25 per horse-power. On the other hand, with a regular flow, we will say that a capacity of 5,000 horse-power could be produced. The initial outlay of the undertaking would then be only $10 per horse-power.

Navigation

Here again appreciable advantages would be derived from the regulation of rivers and streams. It would aid navigation by putting an end to the formation of sand bars caused by the erosion of the banks through freshets, and assure a sufficient depth of water throughout the season.

Conclusions

The report contains the results of the investigations of the committee with special reference to the conditions existing on the St. Maurice and its tributaries, and strongly advises the government to undertake the expense of creating storage reservoirs. The falls on the St. Maurice River between the La Loutre Falls and the St. Lawrence River number 34, ranging in head from 136 feet down, and having a total of 869 feet of fall. As showing the advantages to be gained from the installation of storage dams, it is calculated that the approximate horse power available under the present minimum flow counting eighty per cent. efficiency of machines, totals 306,048 h.p. This could be increased by the building of dams above the falls by 55,272 h.p., making a total of 361,320 h.p. Under conditions of proper storage, however, the approximate power available, counting 80 per cent. efficiency as before, is placed at 1,055,652, an increase of practically 200 per cent.

Summing up the results of their investigations, the Commission reaches the following conclusions:—

(a) There is no further need to demonstrate the exceptional importance attached to the conservation of waters, and the benefits to be derived from the measures for regulating the flow of our rivers. The work of assuring the permanence of our water-powers is of paramount importance. But it is likewise possible to greatly increase their value, capacity and efficiency. And this source of energy, which enlightened foresight can render inexhaustible and manageable, is a capital which we have every interest in keeping intact, and making fruitful, all the more so that the price of coal is rising rapidly and there is none in the territory of our province.

(b) The storage of the waters of the Upper St. Maurice could be effected by means of a storage dam erected near the rapids of La Loutre, whose capacity would be 160 billion cubic feet and which would cost about $1,300,000—a project which presents itself under absolutely practical and advantageous conditions—and plans, specifications, etc., should be prepared by one or more competent engineers for calling for tenders and the execution of the work.

(c) The carrying out of the plan would add at least 600,000 horse-power to the river's capacity and to the hydraulic wealth of the province at the slight cost of $2.25 per horse power.

(d) At the same time we should have an even flow and the elimination of disastrous freshets to the great advantage of industry, navigation and the driving of logs on that river.

(e) The regulation of the St. Maurice is of urgent necessity; the principal interested parties—the grantees, mill-owners and others who use its waters—are eagerly asking for it.

(f) Three periods of low water will elapse between the moment when the works will be begun and the time when their effects will be felt. Each period means a loss of several hundred thousands of dollars.

(g) This project, in its entirety, is one of the greatest of its kind in the whole world. And yet, as compared with other similar works, the cost of erecting the barrage would amount to but a small proportion of the cost of the others owing to the immense superiority of its volume of storage.

(h) As regards the monetary side of the project, the Commission sees a way to provide for it itself without its being necessary to have recourse to the Provincial Treasury for the execution of the works.

(i) The fixed annual charges and those of maintenance would be modest, if not trifling, compared with the benefits to be derived. It is certain that from the very outset more can be done than merely make the general charges and the revenues balance. In fact there is reason to foresee that, in the near future, the province would derive a considerable and sure yearly revenue from it.

(j) Indirectly, the province would have an additional increase in its revenues owing to the economic and industrial development of that region. For all these reasons of public utility and economic interest the Commission on Running Waters is of opinion and recommends that the plan of works elaborated in all its details in this report for the regulation of the waters of the St. Maurice, be carried out as soon as possible.

To that end, the Commission respectfully submits that it would be expedient to grant it further powers in order to enable it to diligently and effectively pursue the realization of that great project, which will mark an era for our province in the growth of its wealth and well-being as it tends to enhance the value of its natural resources and to their more thorough utilization.

Saskatoon Will Extend New Railway

The city of Saskatoon will expend $100,000 during the year in extensions to their new railway system. This will include double tracking and the laying of new switches as well as additions to the rolling stock which it is considered will be necessary if the service is to be kept up to the desired standard. It is also expected a new turbo-generator will be required of probably 2000 kw. capacity. This will almost double the present capacity which is not quite 3000 kw. It has not been decided whether the new rolling stock will be double or single truck, the decision hingeing largely on whether the bridge over the Saskatchewan river is sufficiently strong to carry the double truck cars. It is understood a rate of 2.75c. per kw. hour will be charged the street railway department.

Value of Storage Batteries in Central Stations

Figures Based on Actual Results of Two Years' Operations of a 12,000 Ampere-hour Battery in Central Station Supply

By F. H. Whysall, A.M.I.E.E.*

This paper is for the most part based on the results obtained over two complete years' working of the 12,000 ampere-hour battery installed at the Manchester Corporation Electricity Works, Dickinson street, in March, 1910. This battery was at the time of its installation the largest ever constructed and has a maximum discharge capacity of over 15,000 amperes.

In times gone by, this Institution has dealt repeatedly with the question of secondary batteries; but most of such papers have been concerned with the construction or behaviour of batteries without special reference to the particular object for which they may have been installed. It will readily be realized that before so large a battery as that at the Manchester Corporation Electricity Works, Dickinson street, could be recommended, the saving to be effected by its use had to be most thoroughly and carefully examined. Not only had the initial cost of the battery to be compared with that of an alternative increase of generating plant, but the method of using a battery, whether on lighting or traction and over what periods, had to be decided.

It is now two years since the battery was installed, and the object of the present paper is to show to what extent the predictions as to its use have been fulfilled, and what relief has been obtained in the cost per unit supplied. The author thinks it will be admitted that the battery has thoroughly justified itself during this period, and the figures in this paper should tend to encourage other engineers of central stations to go and do likewise.

Although details of the battery arrangements have already been published, it is necessary, in order that this paper may be complete and clear, to put down for reference the more important data of the equipment.

Technical Description of the Battery

The battery consists of 210 cells, each cell containing 38 positive plates and 39 negative plates of the following dimensions:—

Positive plates, 20¾ in. wide × 29 in. deep × 0.4 in. thick.

Negative plates, 20¾ in. wide × 29 in. deep × 0.31 in. thick.

The positive plates are of the Plante formation, cast in one piece, but the negative plates are of the improved box type composed of half grids securely riveted together, the spaces between them being filled with active material. Specially impregnated wooden separators are employed between adjacent plates, and a free space of 8 in. is left at the bottom of the cell for the accumulation of deposit.

The cell boxes are of pitch-pine lined with lead, the outside dimensions of each box being as follows:—

Length, 6 ft. 1½ in.; width, 2 ft. 2½ in.; height, 3 ft. 4½ in.

The following are the guaranteed performances of the cells:—

Maximum discharge rate, 15,000 amperes.

One-hour discharge rate, 8,400 amperes (3,000 kw.).

Charging rate, 4,100 amperes.

Maximum charging rate, 6,500 amperes.

Maximum charging voltage, 2.75 volts per cell.

Ampere-hour efficiency, 90 per cent.

Watt-hour efficiency, 66 per cent. at 1-hour rate (8,400 amperes).

Watt-hour efficiency, 75 per cent. at 3-hour rate (3,900 amperes).

Final voltage per cell, 1.67 volts at 1-hour rate.

Final voltage per cell, 1.78 volts at 3-hour rate.

Weight of each cell and acid complete, 2 tons 19 cwt.

Weight complete battery, 620 tons.

Floor space occupied, 5,966 sq. ft.

Regulating Cells, Boosters, and Methods of Charging and Discharging

The chief advantage attached to the use of regulating cells is that the output of the battery is not limited by the capacity of the boosting plant; and in cases where a battery is used as standby, regulating cells have distinct advantages over boosters. On the other hand, with large batteries the switchgear for regulating cells becomes, with its connections, a very cumbersome piece of apparatus, and the usual practice is to have booster regulators, automatic or hand-regulated, except for standby batteries and batteries of small size. Traction batteries always have automatic boosters, and in all cases where boosters are used it should be possible to parallel the battery without boosters in circuit under breakdown conditions.

The reversible booster enables all the cells to be used equally, and avoids the necessity of cutting out regulating cells when fully charged.

With larger batteries the cost of reversible booster and battery is less than for battery with regulating cells plus charging booster, which is necessary in any case. The efficiency in both cases is about the same.

In the United States of America batteries are frequently installed large enough to supply the whole load of the system for a short time in case of a total failure of the generating plant; but this is not usual in this country. In such cases regulation by regulating cells is adopted, and in extreme emergencies the battery can be called upon to give an enormous discharge far exceeding its normal rating. It is important that the discharge should not be limited by the carrying capacity of the booster, a regulating switch can be overloaded to a much greater extent without any serious injury.

Further, when batteries are used only in case of breakdown, if a reversible booster were used either the booster would have to run continuously with no load, or else when a sudden breakdown occurred the battery would not be immediately available. Where a battery is put in to reduce fluctuations in the load on the generators it is also looked upon as a standby, but this is not its principal function; further, at times of heavy load the reversible booster would in any case be running.

The chief duty of the Dickinson street battery is to take 3,000 kw. off the lighting peak. It is also looked upon as a standby. But its chief duty is load-levelling; and it was therefore decided to have three hand-regulated reversible boosters, as shown in Diagram A, Fig. 1, and to run them in parallel at times of maximum discharge. At other times, one or two would be used as required. It may be noted, however, that such importance is attached to the question of overload in emergency that it is the universal custom on the Continent to use regulating cells in all central-station batteries.

In this country, the first large batteries with which re

*Presented before the I.E.E.

versible boosters were used were those installed by the Charing Cross, West End and City Electricity Supply Company some twelve years ago; in fact, these were the first important central-station batteries installed for taking the peak load. In this case the transmission is by high tension, and a battery unit giving about 400 to 500 kw. is installed in each of the seven sub-stations. Since that time the number of important batteries has been steadily increasing; but they are all used in the same way, with one exception—where a combination of regulating cells and reversible booster has been adopted so

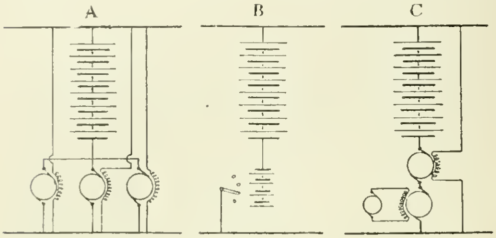


Fig 1

that the battery can be discharged and regulated to a limited extent, even when the booster is not running.

At Dickinson street the battery was also arranged for use on the traction supply; and for this duty a series-parallel arrangement was made of an extra busbar and change-over switches for one booster.

Short-circuiting switches are provided for all booster busbars, these switches being used to cut out the boosters under breakdown conditions, or when boosters are not required, for instance on Sundays, when the battery does the whole of the lighting load for the greater portion of the day.

The lighting load is much bigger than the traction load, and for some time it has been found more economical for that reason to confine the use of the battery to the lighting load. The boosters worked quite satisfactorily on traction with automatic exciter regulation as shown in diagram C, Fig. 1, but the saving effected in works costs was not so great as when the battery was used on lighting alone.

It was originally intended to charge the battery on traction, thereby providing a constant load for one 1,800 kw. traction generator, and enabling it to do the whole of the traction load for the city area by discharging over the traction peaks; also to change the battery over to lighting for the lighting

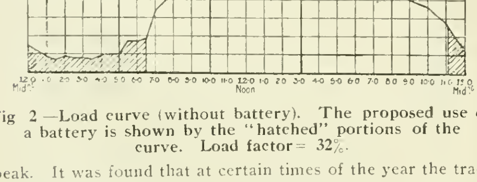


Fig 2—Load curve (without battery). The proposed use of a battery is shown by the "hatched" portions of the curve. Load factor = 32%.

peak. It was found that at certain times of the year the traction and lighting peaks were coincident, and for this and other reasons stated, its use is now confined to lighting. When the traction and lighting peaks are not coincident the battery now virtually does both, because it is made to take up the duty of the set which is changed over from the lighting system to traction to supply the traction peak load.

The boosters are of the Turnbull-McLeod automatic reversible type, and were manufactured by the Lancaster Dynamo and Motor Company. They have equalizing rings to every turn of the armature windings, on account of the heavy circulating currents, and the yokes of the boosters are laminated. Each booster is capable of a maximum boost of 5,600 amperes at 80 volts for a few minutes.

The switchgear consists of 10 panels:—one main battery panel; three booster generator panels, 1, 2, and 3; three booster motor panels; one diverter panel; one booster short-circuiting panel; and one exciter panel.

Two substantial circuit-breakers are inserted in the main cables as close as possible to the battery house. These circuit-breakers are of the magnetic blow-out type, and are capable of carrying 15,000 amperes continuously. Each is enclosed in a separate concrete cubicle so as entirely to shield it from all other parts of the station, and each is electrically

Fig. 3.—Load curve (with battery in use). This curve shows the load on the steam plant. Station load factor = 43.5%.

and independently operated from the switchboard by means of solenoids.

The circuit-breakers are non-automatic, and are provided with a suitable controller to show by means of signal lamps on the operating panels whether the circuit-breaker is closed or open. The large circuit-breakers on the main switchboard are of a similar type, but mechanically operated from the front of the panels. The circuit-breakers themselves, however, are also enclosed in concrete cubicles. The switchboard circuit-breakers are automatic.

The busbars and connections are carried on a very substantial iron framework at the back of the main board; and here, again, the lay-out has been designed with the object of separating the various busbars by enclosing each in a concrete trough. Busbars of aluminium have been employed throughout.

The main 15,000-ampere change-over switches are constructed of a number of parallel strips clamped together with suitable distance-pieces between, and these interleave with contacts of similar construction. Bolts pass through both contacts, and these can be tightened up when the switch is closed, making excellent contact.

Field for Economies in Central-Station Practice

The improvement effected in the load factor of steam plant really covers everything; but a list of items under this head may be given in detail as follows:—

(a) Saving in standby boilers required: Equivalent to 1-hour rating of battery, owing to extra time avail-

able to raise steam, and owing to possibility of applying load gradually.

(b) Saving in capital expenditure, and corresponding annual charges thereon.

(c) Saving in wages of running staff.

(d) Saving in cost of peak-load units.

(e) Saving due to "buffering," i.e., load-levelling, enabling all units to run at their most economical load.

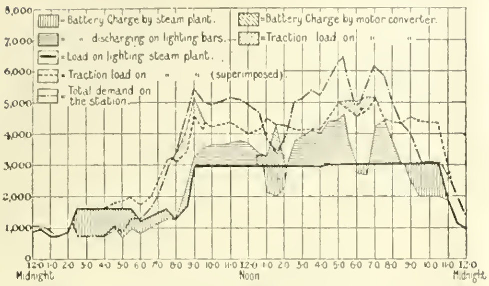


Fig. 4.—Summer load curve. Load factor on steam plant = 67.5%; on max. demand = 54.4%; improvement in load factor = 13.1%.

The value of all these items can be variously ascertained as detailed in the following text, and usefully checked against each other. It will also be seen how engineers may safely estimate the possible saving to be expected of any proposed battery installation.

In Fig. 2 is shown a typical winter-load curve at the time of the installation of the Dickinson street battery, the hatched portion of the curve representing the duty proposed. Fig. 3 shows the expected resultant load curve for steam plant with battery installed.

The load factor in Fig. 2 works out at 32 per cent., and is improved to 43.5 per cent. in Fig. 3. In Figs. 4 and 5 we have typical summer and winter-load curves since the installation of the battery, and it will be noted that the load factors obtained are actually much greater than those anticipated, and are respectively 67.5 per cent. and 49.1 per cent.

In Fig. 6 a chart is given showing the effect of load factor on coal consumption and works cost at Dickinson street and Bloom street works. This chart has been plotted from actual results obtained over a period of eight years, from 1904 to date, and checked by over 100 monthly observations. This process has eliminated very largely any irregularities which might have occurred in the curve due to abnormal conditions apart from the effect of load factor.

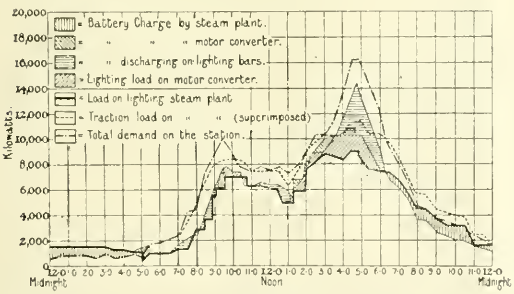


Fig. 5.—Winter load curve. Load factor on steam plant = 49.1%; on max. demand = 34.4%; improvement in load factor = 14.7%.

Dickinson street is now considered an old station, and the largest units at Dickinson street and Bloom street stations are of not more than 1,800 kw. capacity. Attention should be drawn to the fact that the observed coal consumption per unit of the combined stations—has been down to the low figure shown on the chart. The lowest figure for a monthly observation per unit generated since the installation of the battery is 2.66 lb., and per unit sent out 2.79 lb., the difference being accounted for by units used at the Works and units lost in the battery. The commercial efficiency of the battery was for the first year 70.6 per cent., and for the second year 71.1 per cent.

It is quite unfair to consider a battery capable of saving only the standby represented by its 1-hour rating capacity. In the storm-load chart, Fig. 7, the maximum demand (ignoring traction) was 44.5 per cent. greater than the boiler capacity at the commencement of the darkness; and the battery was able to take care of the rising load as shown, ahead of the extra boilers which had to be got into commission. Without the battery it would have been impossible to get these extra boilers up in time. In other words, it would have been impossible to keep steam, and would have meant practically a total failure of supply unless some portion of the load could have been cut off. What might be described as the elasticity of the system due to the battery makes the question of boiler standby much easier, and less boiler plant is required to meet a given load when such load can be put on gradually.

It is possible to get up 20 boilers in the same time as one, given the necessary men, and what happens in practice is this: When it is seen that extra boilers will be required

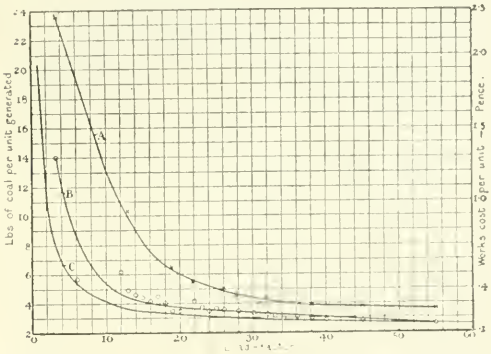


Fig. 6.—Curve A: Works cost per unit generated in pence. Curve B: Pounds of coal per unit generated (from actual observation). Curve C: Pounds of coal per unit generated (by formula).

they are lighted up, and the battery is eased by the running plant until the steam pressure begins to fall. The battery is then called upon to supply the rising load until the extra boilers are steaming. This process may be repeated and other boilers got away, the constant effort of the engineers-in-charge under these circumstances being to get the battery off discharge and to keep it fully charged in reserve to meet the final peak of the load.

Capital Cost

The increased use of large batteries in central stations during the last few years has been chiefly due to reduction in first cost owing to improvements in design, i.e., a greater percentage of lead employed is active material; for instance, positive plates have probably two or three times the surface of plates of the same weight made twenty years ago. There is also a reduction in capital cost of manufacture, principally in the formation, the present rapid processes taking only a few days, instead of many weeks, as formerly. Other im-

provements in manufacture are the use of better methods and tools, in keeping with general industrial progress. There is also a reduction in cost of upkeep and improved reliability; but these come under another heading.

When the Dickinson street battery was proposed, the estimated comparison of capital costs was as follows:—

The hatched portion of Fig. 2, previously mentioned, shows the portion of load which it was thought desirable to transfer from the generating plant to the battery, representing the peak load on a two-hour base, or all load of less than 8 per cent. daily load factor. By measuring the mean area of this hatched portion, we arrived at the "units of output," e.g., on the curve shown the figure is 3,000 kilowatt-hours, equivalent to about 7,000 amperes for one hour. With this datum as a basis, it was easy to estimate the size of battery required. Thus:—

Rate	Output	Equivalent in Amperes
1 hour	3,000 kw.	8,400
2 hours	2,000 „	5,000
3 hours	1,500 „	4,000
Emergency ½ hour	4,500 „	11,500
5 minutes	6,000 „	15,000

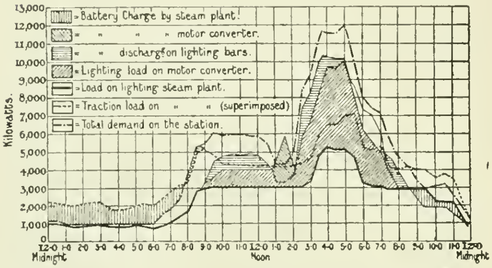


Fig. 7—Storm load curve. Load factor on steam plant = 55.0%; on max. demand = 32,6%; improvement in load factor = 22.4%.

Capital Cost of Generating Plant for 3,000 kw.

3,000-kw. steam plant at Stuart street (excluding buildings but including all else)	£36,000
High-tension cables for 3,000 kw.	5,000
3,000 kw. sub-station at Dickinson street	10,000
Total	£51,000

3,000 kw. battery plant at Dickinson street (at 1-hour rate of discharge, and including boosters and switchgear)	£18,000
Buildings	2,000
Total	£20,000

Difference in capital expenditure: £51,000—£20,000=£31,000.

Interest and Sinking Fund

Steam plant: £51,000 to be repaid in, say twenty years:—
Interest ... ... 3½ per cent.
Sinking Fund . 3¾ „ „

7¼ per cent. = £3,698

Battery: £20,000 to be repaid in, say, ten years:—
Interest ... ... 3½ per cent.
Sinking Fund . 8¾ „ „

12¼ per cent. = £2,450

Difference in favour of battery ... £1,248

The actual costs came out as follows, using the same figures for steam plant for Stuart street, high-tension cables, and sub-station as before.

Actual Cost of Battery Plant, Dickinson Street

3,000 kw. battery at 1-hour rate of discharge, including boosters and switchgear.

	£	Loan Period
Storage battery	15,034	7 years
3-motor booster combination	2,776	15 „
Switchgear	1,757	15 „
Buildings	2,000	20 „
Total	£21,567	

Estimated steam plant expenditure, as above	51,000
Actual cost of battery plant	21,567
Difference in capital expenditure	£29,433

Difference in Interest and Sinking Fund

Steam plant: £51,000 to be repaid in, say, twenty years:—
£3,698 (as above)

£21,567 to be repaid in ten years years:—
Interest ... ... 3½ per cent.
Sinking Fund . 8¾ „ „

12½ per cent. = £2,642

Saving in capital charges per annum in favor of battery ... £1,056

Comparison of Cost Per Kilowatt of Capacity

	Estimated	Actual
Generating plant	£17 0 0	£16 16 6
Battery	6 13 4	7 3 9

In these days of turbo-driven units, the capital cost might be taken at a lower figure.

Below are given estimated costs by Mr. J. F. C. Snell in his book on "Power House Design."

Lay-out of Proposed 120,000-kw. Power House at Barking Creek for Bulk Supply to the County of London

Rated output of Power House, 120,00 kw.; Overload, 150,000 kw.

	Capital Cost	Cost per Kilowatt. Rated	Overload
	£	£	£
Land	50,000	0.41	0.33
Buildings	344,000	2.87	2.30
River work and pier	102,000	0.85	0.68
Coal and ash plant	59,000	0.49	0.40
Boilers and economizers	199,000	1.66	1.33
Pipework and pump	105,000	0.88	0.70
Turbo-generator and condenser	430,000	3.58	2.86
Switchgear, etc.	67,000	0.56	0.44
Engineering expenses and contingencies	115,200	0.96	0.77
Total	1,471,200	12.26	9.81

General

Average cost of power house buildings in large cities, £6 11s per kilowatt.

Average cost of power house building in smaller provincial towns, £3 5s to £6 per kilowatt.

Average cost for larger power houses outside cities, £2 5s to £3 per kilowatt.

Generally speaking, the cost of plain substantial buildings may be reckoned for estimating purposes approximately as follows:—

£		
5.00 per kw.	for	2,500 kw. installed.
4.00 per kw.	for	5,000 kw. installed

£ 2.75 per kw. for 25,000 kw. installed.
3.25 per kw. for 10,000 kw. installed.
2.50 per kw. for 50,000 kw. installed.
2.33 per kw. for 100,000 kw. installed.

Costs compiled from the latest actual figures available are estimated by the author as follows:—

	Total Cost per kw. £ s. d.
Land	0 5 6
All buildings (including offices)	3 13 0
Land for railway, railway complete and locomotive	1 9 0
Coal and ash plant	0 4 0
Marine boilers with superheaters, including economizers, coal and ash chutes, scraper and stoker driving	2 13 0
Foundations and flues for marine boilers	0 9 0
High pressure steel pipes and covering, including valves. (Main range not included)	0 2 6
Turbo-alternator and condensing plant, pipework for condensing plant and motor-driven fans	3 5 6
Foundations for turbo-alternator and air ducts	0 4 0
Pipework for turbo-alternator, including circulating water pipes, atmospheric exhaust pipes and valves	0 5 0
Natural draught cooling towers	0 13 0
Foundations for cooling towers	0 5 0
High-tension cable	1 8 0
Converting plant, including switchgear	2 0 0
Total	£16 16 6

Total plant installed ... ... 56,500 kw.

It should be noted that Mr. Snell's figure of £12.26 per kilowatt does not include items in the author's estimate amounting to £5 4s., which would bring up the cost per kilowatt on his estimates to £17.46.

It would seem, therefore, that for peak-load duty of two hours (which averages out at the 1-hour rate of discharge for the battery) the cost per kilowatt can be safely estimated at £17, which leaves a margin of £9 16s 3d in favor of the battery.

Running Costs

It is necessary when considering the cost of generation of peak-load to take into consideration the fact that the most uneconomical units are reserved for this duty, and quite rightly so, also that these peak-load sets will not be run at their most economical load; consequently the steam consumption will be high. Bare fuel cost per 1,000 kw. standby for this peak-load duty the author has estimated at £7 per week, or reckoning five days per week, £1 8s per day. This latter charge becomes in the case of a 3,000-kw. battery £4 4s per day for the bare 1-hour rating of the battery. But we have seen previously, when considering the effect of the battery on load factor, that it is unfair to credit the battery with standby savings on its bare capacity only; and in Fig. 7, showing the storm-load curve, it is demonstrated that the battery saved standby to the extent of 44.5 per cent. on the total boilers under steam at the beginning of the day, also that more boilers are necessary to meet sudden demands that can comfortably cope with an equivalent load applied gradually. We may safely assume, then, that on this occasion a 3,000-kw. battery saved standby for its own capacity plus 44.5 per cent. of the boiler capacity prior to the storm, which was 7,200 kw. On this, 44.5 per cent. is 3,200 kw. Calculating at the same rate without allowing anything for the increased price of coal, we see that our 3,000-kw. battery at this time of the year, say, the five summer months from March 31st to September 1st, is equal to steam standby at the rate of £8 8s. per day. Reckoning on the basis of five days per week gives £924. Adding £630 to this on account of the standby saving for its own capacity for the other seven months, we have a yearly standby saving of £1,554.

Below are some observations at the city stations in corroboration of the author's estimate of standby charges over some months when steam standby had to be maintained. These figures were obtained by comparing the corresponding periods of the year previous when standby was not maintained.

Month	Tons of Coal	Cost £	Standby kw.	Cost per Week per 1,000 kw. £ s.
April, 1911	488	255	8,000	8 0
May, 1911	203	105	5,000	5 5
June, 1911	388	200	5,000	10 0
July, 1911	504	263	8,000	8 0

It must be admitted that it is only fair to charge the battery with bare fuel costs corresponding to the input, because there is an actual saving on running fixed charges on the station when a battery is put in. The author supports this statement by saying that at Dickinson street there are now twenty-two fewer men for an increased demand since the installation of the battery. Comparing bare fuel cost per unit generated, and crediting the battery with a commercial efficiency of 70 per cent., we get a cost per unit (reckoning 2.5 lb. of coal per unit at 12s 5d per ton) of 0.237d. against a cost of 1.55d. taken from the actual results shown on the load-factor curve for 8 per cent. load factor. The peak-load units discharged by the battery since its installation, calculated at the rate of five complete discharges per week—March 31st, 1910, to March 31st, 1912—are 1,560,000, and represent an annual saving of £8,534. This takes no account of the morning discharges and load-levelling duty during the rest of the day, commonly called "buffering," whereby each set on load is kept running at its most economical output, and sets do not need switching in and out to meet the vagaries of the demand. This can also be estimated from the load-factor chart.

The improvement in load factor on the units generated, observed monthly over two years, is approximately 7½ per cent., and the value obtained from the chart is 0.08d. on 30½ million units; this represents a saving of £10,166.

We have, then, two distinct annual savings on running charges due to the battery: (1) Standby boiler fuel costs; and (2) difference between steam generation at 8 per cent. load factor and fuel bare cost—and as a check on these we have the saving indicated on the load-factor curve due to the improved load factor, which to be accurate should be reckoned for each month separately. This is the actual improvement due to the battery, and should cover both the other estimates and include the saving due to the buffering effect as well, because the later observations shown in Fig. 7 were made after the installation of the battery. In fact, estimated savings from the load-factor curve should cover all savings on running costs when taken on the whole output. It should be noted here that there is a theoretical curve drawn in on the load-factor chart, based on a test figure obtained for the city stations of 2.5 lb. per kilowatt for 100 per cent. load factor, and the known standby fuel charges as previously detailed. It is necessary also to mention that when Stuart street works act as standby to the city stations allowance is made and included in the fuel costs, from which the actual curve of cost is drawn. The whole of any improvement shown is therefore due to the battery alone. These remarks do not apply to the actual coal load-factor curve, which benefits to some extent from the use of the sub-station, and accounts for its nearness to the theoretical curve. The lowest observations, however, on both the coal and cost curves were, of course, made some years before the installation of the battery, and the lowest one of all was made when the plant was running non-condensing

at Dickinson street (on account of alterations to the circulating water culvert). For condensing, of course, these two points would be lowered approximately 33 1/3 per cent.

Actual Results with Dickinson Street Battery

In the table the actual saving on works costs for one complete year's working is given, showing the saving actually made. Nothing has been said about battery maintenance so far; but it should be noted here that the makers have signed a contract to maintain the battery at its rated capacity for a term of fifteen years for the sum of £1,250 per annum, which is 8.3 per cent. per annum on the purchase price. This maintenance is included in the works costs.

	1909 No Battery	1910 With Battery
Output to feeders in kw.h.	25,818,992	29,042,985
Coal used	40,681 tons	39,418 tons
Average price of coal	10s. 11d.	11s.
Increase in coal cost, 1910—1911		£164
Total cost per unit output to feeders	0.368d.	0.368d.
Saving in 1910-11 against 1909		£7,620
Total value of saving effected by battery with coal at 10s. 11d.		£7,784
Commercial efficiency		70.6%

Note.—Calorific value varies between 13,500 and 14,000 B.t.u's per lb.

Summary

Capital Cost.

Saving in favor of battery: First cost, £29,433; annual charges, £1,056.

Annual Running Cost.

Saving in favor of battery.—

	£
As per first year's working under favorable conditions	7,620
Total annual saving in favor of battery	8,676
The estimated saving from calculated standby value was per annum	1,554
From difference in cost of generation between fuel cost and cost at 8 per cent. load factor	8,534
	£10,088
The estimated saving from load-factor improvement was	£10,166

and it must be admitted that the two different ways of estimating the saving check very well with the actual results.

Load-Factor Curve

A load-factor curve showing fuel values can be constructed for any works providing the standby fuel charges are ascertained for a representative boiler, and the fuel consumption per kilowatt-hour at 100 per cent. load factor is known for a representative unit.

The formula used by the author is as follows:—

$$x = \frac{c}{y} + k.$$

where—

x = lb. of coal per unit.
c = standby fuel per kilowatt capacity.
k = running fuel per kilowatt capacity.
y = load factor.

Example for city stations:—

$c = 0.18$ lbs., $k = 2.32$ lb., $c + k = 2.5$.
$y = 50$ per cent. $= 0.5$.

$$x = \frac{0.18}{0.5} + 2.32 = 0.36 + 2.32.$$

$= 2.68$ lb. per kilowatt-hour.

Records and Care in Use

In the first place, a recording ammeter and a recording voltmeter are essential in order to see that overcharging or overloading does not take place; the former is shown by the voltage line at the end of charge, and the latter can be ascertained by comparing the discharge rates shown on the ammeter chart with the corresponding final volts shown on the voltmeter record. Overcharging is, of course, a matter of definition, and depends on the state of the cells. Charging is continued under normal conditions at Dickinson street 10 minutes after gassing point is reached, before both daily discharges, and for 2 hours once each week, generally on Saturday, and preceding the day (Sunday) when a complete discharge at the 10-hour rating is usually taken out of the battery.

It is the custom to construct daily load curves at Dickinson street like those shown in Figs. 4, 5 and 7, except that colors are used to indicate the various areas. These charts have a very important moral effect, and are daily placed in a frame on the battery switchboard for inspection and for future guidance.

The efficiency of the battery for the day is worked out thus:—

$$\frac{\text{Units output}}{\text{Units input, including booster units}}$$

which we term the "commercial efficiency."

The improvement in load factor on the steam plant is noted, also the ampere-hours of the peak-load discharge. These figures are put on the load curve, and it is easy to see at a glance if the battery is not being used to the best advantage. These load curves are considered the most important records taken, because the value of a battery depends more on the way it is used than on anything else.

A special battery-book is kept, giving details of cell defects and their treatment (for which a 1,000-ampere portable "milking" booster is used), daily gassing, weekly overcharge, and all specific gravities and voltages of individual cells once each week after the weekly overcharge. Three pilot cells are used to serve as a guide to the state of charge, and the specific gravities of these cells are taken every half-hour for the station log sheet, which is the general record of the working of the station usually found in use at most central stations.

The capacity of the battery varies at various rates of discharge, and without these pilot-cell readings it would be exceedingly difficult at times to gauge the exact state of the battery.

General Conclusions

Advantages and Disadvantages.—When considering the value of storage batteries in connection with central station supply, it has been the general custom in the past to compare the cost per kilowatt of capacity with that of steam plant and generator, to the advantage of the latter. It was argued that steam plant and generator cost less, and could be run continuously if required, whereas a battery (if the 1-hour rating was used for comparison) was not to be relied on for longer periods than one hour. It was, and is still, held that the life of a battery would be less than half that of generating plant, that maintenance is exceedingly heavy, operation difficult, and still—speaking generally—a prolific source of worry and trouble.

Batteries were installed, when central stations were first built, large enough to maintain the supply during the night, and at the week-ends, without the assistance of running plant. They were found a great convenience; but generators would be added as the demand on the station grew, and the battery would fall out of use, except for balancing purposes, until, through neglect and ill-usage, it would become of no

value to the scheme. In no case would the battery be used except as a luxury, and it was generally expected to require no attention until it got into a very bad state.

Electric traction did something to raise the reputation of storage batteries, owing to the marked saving in plant required for a rapidly fluctuating load, and the resultant economies of this buffering effect.

A properly proportioned battery is supposed to give 1 per cent. to 2 per cent. better ampere-hour efficiency when used on traction as described, and as against the efficiency of a battery used to deal with lighting peaks, due to the greater buffering effect on traction loads.

It is now being recognized that, provided the battery is installed to reduce generating plant, it is a sound commercial proposition when considered in connection with a large lighting load.

Popular Error about Efficiency.—Too much has been made in the past of the supposed inefficiency of batteries; as a matter of fact 70 per cent. to 75 per cent. commercial efficiency can be maintained with care; and if this were not so, efficiency is the least important attribute of peak-load plant, and especially so in the case of a battery. Peak-load units are costly to generate, and allowance is made for this in fixing charges for lighting. Power or daylight units are much lower in price because the cost of generation is much less—so in effect the battery is charged at power costs, and discharged at lighting rates. If some of our large consumers on public supply mains only realized this, they would install batteries of their own, buy current at power rates, and cheapen their own lighting supplies by arranging with the supply authorities for a "restricted-hour" supply, i.e., they would take no current from the mains at peak-load time.

Batteries hitherto have usually only been installed by consumers for the sake of making supplies reliable and independent of accidents outside their own premises.

Importance of Size and Application.—It does not matter how short a period of time during the day, or the year for that matter, a supply is demanded, there must be plant installed to meet it, and it has been found that for all duty of less than 8 per cent. daily load factor, i.e., of less than two hours' demand during the 24 hours of the day, the matter is in no doubt. It most certainly pays to make storage battery provision for this. Beyond this point we must look to advantages other than direct saving in capital cost and running charges to justify the extension of the principle.

It is often said, "What about the overload capacity of the steam plant; is not this sufficient to deal with the peak the battery is intended for?" On occasion, yes; but if reliability of supply is to be assured, the occasion must be that brought about by the failure of the battery, a possible but unlikely occasion if proper care is taken.

Booster regulating plant can go wrong, and batteries are protected normally by circuit-breakers which may open through defect. It is generally possible, however, in the event of serious trouble to parallel the battery without the boosters in circuit; and under such circumstances the battery would prevent total failure of supply under the worst conditions. From other causes of failure a battery is practically free.

It is very important that the battery should be of large enough capacity, not only for normal discharges, but for any short, heavy loads it may be called upon to give out. On the other hand, if the battery is larger than would be necessary to deal with load of the proportions indicated, the direct saving it is possible to show is correspondingly decreased.

Electric Rates and Classification of Customers

Extracts from a Report Prepared by a Member of the Rate Research Committee of the N. E. L. A.

When a business is subject to unlimited competition, all its rates automatically seek a level where they give the owner barely a minimum return, or possibly provide no profit at all, since, when they rise above this level, more competition develops, and when they fall below the competition ceases until they rise again.

In the case of a monopoly, and particularly of various public service monopolies, the rates are not entirely controlled by competition, and in the case of public service monopolies, it is expected that either public sentiment, the courts, or commissions, shall regulate the rates to a point at least as low as they would have been in the long run, if subject to competition.

The degree of monopoly of public service corporations is greatly overestimated, since most of their monopoly is in form only. An electric company may have exclusive rights to supply electricity for light, power, heat, etc., but it has no monopoly in the supply of light, power or heat as such. In the case of electric light it has as active competitors, candles, oil and gas; in the case of electric power, it competes with animal power, gas and oil engines and steam engines; in the case of electric heat, with gas, oil, coal and blankets, and in spite of what may seem to be a monopoly in the supply of these services in the electric form, it finds tremendously active competition in substance—competition which seriously affects its business the moment it raises its prices above a certain point. Below a certain point in its prices, the electric company may have a monopoly, and public sentiment requires that its prices shall, in the long run, be lower than if the competition were unlimited, and this point is where all the prices together produce just a fair return on the investment.

It is for the interest of the owners, as well as of the public, to keep the prices at this point, but for any given short period the owner is always attracted by the idea of a high return and high dividend, so that the apparent or momentary interests of the owner and public may seem to be opposed. However, while the interests of the owner and of the public are at any moment apparently opposed on the question of the total profits, there is another question on which the interests of the owner are not opposed to those of the public, and that is the division of the total profits as coming from the different customers. To secure a given return on a certain investment, it makes no difference to the owners whether this comes mostly from power, or mostly from light; mostly from large customers, or mostly from small, and when the total profits are unaffected there is nothing to lead the owner to take any action, in the way of changing this division adversely to the public interests.

The question of division of costs among different customers or classes, is an entirely separate question from the question of total costs or fair return. Having decided finally, or for the time being, what is a fair return on the investment in a given electric or other public service company, the separate question is still open—how shall the rates that are to produce this income be adjusted as between the different classes of customers?

The first answer (and a theoretically correct one) is

that each individual customer should be charged at least what it costs to serve him. The trouble is that this only distributes a small portion of the costs as between customers. If an electric light is burned, or motor used, the electric company uses perhaps a little more coal, costing perhaps ½ cent per kilowatt hour for each kilowatt hour used, but the rest of the expenses are not immediately affected. They are joint costs which may belong to any of the lights or any of the motors, or to some other part of the business.

In many businesses—and especially such a business as electric light and power service—most of the expenses are the same whether any particular customer uses the service or not, and it is only certain small expenses that are necessarily part of the cost of each customer. These latter are sometimes grouped under the general term the "increment cost," the cost incurred by adding that customer to the system, or saved if he is disconnected. The remaining and greater portion are joint costs, which may belong to all of the customers or the customers as a whole. Increment costs must be, or rather should be, apportioned to individuals, or special classes that cause them. Joint costs must be divided in some way as between all the customers.

No absolute accountant's line can be drawn between increment and joint costs. For instance, in railroad freight, suppose a given traffic goes south. So long as cars come back empty the increment cost of extra freight north is only handling and a little coal. All the rest is joint expense to be divided in some way among all the traffic. The moment the traffic north becomes big enough to require extra trains, then the increment cost in that particular case is high, and at that moment increment cost for freight in empty trains now going south becomes small.

It follows that the increment cost which is necessarily incurred by a customer is usually very small, unless we can be sure that he is always the "straw that breaks the camel's back." The fact that he happens to cost a great deal should not be charged against him unless it is always going to require that extra expense to serve him; unless he, or his class, is always going to involve an expense, it is a joint cost and not an increment cost.

It is important to remember that for electric companies and for most public services, these joint costs are by far the most important portion of the total expense. It is seldom that it makes much difference to a railroad whether a single passenger does or does not get on the train. The expenses are the same whether he happens to be aboard or not. It is seldom that it makes any difference to an electric company whether a particular lamp or motor runs or not. It might be possible to compute the effect on the coal pile, but the effect on 90 per cent. of the expenses would be practically nil.

Common Interests of Owner and Consumer

These joint costs must be divided in some way. Now, while the interests of the owner may appear to be temporarily opposed to those of the public on the question of the total of the costs, or the total of the joint costs, the owner, as such, has no interest that would lead him to divide a given total between the customers in any way contrary to the public interest. The question is, how shall the joint costs be divided between the customers that jointly use the service? One method is for the owner or manager to make arbitrary prices to each customer, but it is clearly of no advantage to the owner to charge different amounts under like conditions, and such discriminations are forbidden by law on the ground that they are either due to some improper influence on the manager against the interest of the owner and public, or else an error of judgment.

The simplest method is to select some unit, as ton-miles or kilowatt hours or number of telephone instruments served, and divide all costs in proportion to this unit. Here there is no difference of interest as between owner and public, in choosing the unit, but there will naturally be a difference as between portions of the public. A charge for hotel service by the European plan, helps one class of travellers as compared with a class that prefers the American plan, and so on. Whether an electric company charges per lamp connected, or per kilowatt hour, makes a great difference as between stores and residences, even if the rates are such that the owners of the electric company get the same return on their whole investment. Further, it is perfectly possible to select more than one unit, or, if using a single unit, to make the rate for such unit different for different classes, as one rate for residences and another for business, or one rate for letters and another for merchandise.

Rates by Formula

At the moment there is a call for electric companies to adopt prices as developed from a certain formula, sometimes known as the demand theory. Costs = number of customers × a + kilowatt hours × b + kilowatts of demand × c, and it is well to understand why this, as well as any other formula, would be to the public's disadvantage unless by the merest chance it worked out right for all cases. No matter which formula we use for analyzing costs, it is still true that most of the costs are joint costs not necessarily incurred by any particular customer or customers. Now, if these joint costs are divided in one way according to some formula, there may be still another division which may give better results for the public. If the formula is a sacred one we cannot go behind it, but if not sacred, what test shall we apply to see if it gives the best results? The best result is when the burden on customers is least; i.e., when we get as much business as possible among which to divide the joint costs so that the burden on each customer shall be least.

If we had a growing business, without any existing rates, we should find it difficult to say how we should start, but we cannot imagine a business operating without some rate to start with, and if we have some business and some rate to start with, all we have to do is to see if some change of rates will not give better results and to keep on trying until we can make no further improvement.

Take existing rates. They produce an income which is either less than a fair return, a fair return, or more than a fair return. Now, if the return is less than fair, a new rate applicable only to new business that could not otherwise be obtained, should return something towards joint costs, and will be of no harm to existing business and will be an improvement. If the return is just a fair one, a new rate that produces new business over which to distribute joint costs will not hurt existing business, but will make possible a reduction of rates. If existing rates show more than a fair return, a reduction should be made, but again, if a reduction so as to produce new business is made, further reduction becomes possible.

In any of the cases, it is obvious that the new rate should take as much of the joint costs as it will stand, and this is clearly no injury to the new business, because it need not take the supply unless it wants to, and will not unless it gets some advantage. On the other hand, if new business is asked to share the same proportion of joint costs that is being paid by the old business, it may not be secured at all, and then will not pay anything towards joint costs, instead of paying something.

In a recent article on isolated plants, in the Engineering Magazine, it is stated that the central station operating costs are 1 cent per kilowatt hour (the real cost is usually less). The general expenses are taken at 2½ cents per kilowatt hour. This figure for general expenses probably includes all accounting and distribution expenses, such as maintenance of lines, etc. The article does not give any

figure for the fixed charges on the central station, but says that they are three times what they would be for an isolated plant, and later gives the fixed charges of such a plant as 2 cents per kilowatt hour, which would make the fixed charges for central station 6 cents per kilowatt hour, and would make the total central station costs 9½ cents per kilowatt hour. Then the costs of an isolated plant are given as—operating cost 1 to 1½ cent per kilowatt hour; fixed charges 2 cents per kilowatt hour, and general expenses nothing, making a total of 3 to 3½ cents per kilowatt hour. It is, of course, absurd that an isolated plant has no general expense, and that supervision and management expenses do not exist, and that such services where tendered should not be included in the cost.

The article then wants us to infer from the above that the central station cannot by any possibility sell electricity at 3 cents and make its expenses. The costs for the central station, however, are the average costs, made up of all sorts of expenses, and because they may average 9½ cents it does not mean that each new customer will also cost 9½ cents. Each new customer may add something to the total costs, but this addition will have no relation to the average cost of serving the old customers.

Rates Must Vary

For instance, I recently learned of a case where a central station is supplying to all its customers about 6,000,000 kilowatt hours, with an operating cost at the station of about $60,000, an average cost of 1 cent per kilowatt hour. Its general and distribution expenses of all sorts were about $180,000, making about 3 cents per kilowatt hour; its fixed charges were about $180,000, making about 3 cents per kilowatt hour; the total average cost or price for all its output was therefore about 7 cents per kilowatt hour. This price was collected from its customers at different rates varying from 3 cents to 11 cents per kilowatt hour.

This station then had placed before it a proposition for supplying a single new customer with 4,000,000 kilowatt hours annually. In order to supply this customer all it had to spend in the way of investment was about $30,000 for lines, ducts, etc., and for the increased capacity at the station. This, however, was not quite fair, because the supplying of this customer used up some capacity which was idle, and made it necessary to spend another $30,000 very shortly, which otherwise would not have been spent. The real increase in investment made necessary by this customer was then about $60,000, and to make sure that this was reasonable they got out the figures as to what the increased investment would be if they should take on several more customers like this one, and found it less than $60,000 each.

This is a very important point. If a rate can be established for a single customer, and a different rate for the next one, then the increment cost can be figured for each. If, however, a rate is established for a class, we must figure what is going to be the whole result for years ahead, when not one but many customers of the class are added.

To return to our example. 15 per cent., on $60,000 meant $9,000 a year increase in fixed charges. The operating expenses had been $60,000 for 6,000,000 kilowatt hours, and they estimated that for 10,000,000 kilowatt hours the operating expenses would only be $85,000—an increase of $25,000. The general expenses had been $180,000, but this single large customer, or other customers like him, would hardly add anything to the general expenses, though they put down an increase of $1,000. The net result of adding this large customer, and of still other customers proportionately, was, therefore, an increase in the expenses of $9,000 fixed charges; $25,000 operating, and $1,000 general, or a total of $35,000, which, applied to the 4,000,000 kilowatt hours of use gave approximately .9 cents per kilowatt hour.

It was stated that this customer could make his own electricity for about $64,000 a year, or 1.6 cents per kilowatt hour, and the central station to secure his service made a price that came to $60,000 a year, or 1½ cents per kilowatt hour, and the difference between the $60,000 that the customer paid and the $35,000 that it cost to serve him left a contribution of $25,000 toward the net revenue.

This did no harm to the customers who previously had been paying 3 to 11 cents per kilowatt hour, and as a matter of fact, later enabled the company to make a reduction to these customers, which it would otherwise not have been able to make.

In a case like this we naturally feel that a new customer should contribute as much as possible to joint costs; i.e., should be made to pay, in unpopular phraseology, all his traffic will bear, even if we do not charge him as much as we charge the others. Now, in order to determine what he can actually afford to contribute towards joint costs, it is necessary to figure what it will cost him to make it himself, and in most cases of customers like this the things which determine his costs are his demand, his consumption, and his size; in other words, using as a basis to figure his costs, the demand formula above referred to. Hence, in publishing a rate to attract these customers, it is natural to make it on a demand basis, so that each shall pay as much as possible of the joint charges and reduce their burden on others.

But note: While the demand system furnishes a measure of the total station costs it is not for that reason that we use it in making prices. We use it in making prices because it furnishes a measure of the value of the service to the customer and if in any particular case the demand system did not furnish this measure we might use some other measure in order to apportion to him as much as possible of the joint costs, so that the supply to him should be of the greatest benefit to the other customers.

The "Demand" Theory

Now, this explains in part, at least, the popularity of the so-called demand theory. Everybody uses the analysis of costs into demand and output charges, and finds it extremely useful, first, when applied to the central station costs to determine the effect of changes upon those costs, and, second, when applied to the customers to determine the price which will make the supply to them result in the greatest benefit to the customers as a whole. Even when there is no question of the customer making his own electricity, the demand theory still is apt to furnish a measure of how much the new business can contribute to joint costs.

For instance, a customer with a few lamps used long hours will take the trouble to equip himself with gas and maintain Welsbach burners, unless he gets a fairly low rate per kilowatt hour; while another customer, using the same amount of electricity, but on a large number of lamps, can afford to pay a higher price per kilowatt hour, rather than trouble with the gas outfit. It is, of course, better for both customers to be supplied than for one to use gas, and let the other pay all the joint costs.

The demand theory is very apt to give prices that will be best for all, but this is purely because it happens to fit certain classes of customers. The fact that in some cases the best prices can be figured from a particular cost formula, does not prove that the same figuring will give a correct result when conditions are changed.

To return now to the case of the large customer, there is always difficulty in understanding why it is that a large customer can be supplied at so much less than the average price, but here is another analysis which may make it clear.

The central station could build a new small station for a customer close to his mill, and a duplicate of his plant, and by running it exactly as he would run his plant could meet his costs exactly. In such a case it is clear that the old station costs would be 7 cents and a proper price to old custom

ers 7 cents; cost at new station 1-6/10 cents, and the proper price to the new customer 1-6/10 cents. Then when we combine them and run them as a unified proposition, the situation is still the same, and the cost of each does not become the average, any more than a short man could become taller by enlisting in a company of soldiers whose height averaged more than his.

This point about building a small station close to a customer is a very essential one to remember. The central station can always meet the price of the isolated plant because it can build an exact duplicate of the isolated plant and run it as the customer would run it and meet the price, and then, as a next step, the central station by combining the loads can effect a saving and make a profit. In any case it cannot lose by selling to the customer at what it would really cost the customer to supply himself, because in the worst case it operates exactly as the customer would have operated.

Should be no isolated plants

We contend that there should be no isolated plants from the standpoint of economics. Why, then, are there any isolated plants? The reasons are as follows:

(1) Sometimes the central station does not know its business. The cost of an isolated plant may be said to be 3 cents, but the central station may refuse to supply the service at less than 5 cents.

(2) Sometimes the isolated plant does not know its business. The real costs of the isolated plant may be 3 cents, and the central station may offer a supply at 2.9 cents, but the engineer may report that the plant cost would be only one-half cent, and he secures a commission, or at least a job.

(3) Sometimes the owner of the isolated plant is running it for his health, as a hobby or for amusement. The central station cannot very well make a price that will recognize such conditions.

Occasionally the case may present itself where it is really economical to generate part of the electricity at the customer's premises and part at the central station, as when the customer may have water power available. If this amount at any given time corresponded exactly to the customer's requirements, then for this time there would be no advantage from the central station connection, but practically always some of the electricity could be economically supplied from the central station, or else the water power plant could sell some to the central station.

All Savings Benefit Public

Any savings or contribution to the net revenue of the central station are ultimately for public advantage, because whatever increases the profit of the central station brings earlier reduction of rates to its customers as a whole. Hence, a central station should make rates that will get all the business, and while making the rates just low enough to get the business, that could not otherwise be secured, should make them no lower than necessary and in no case below increment cost.

But suppose we adopt this theory. Is it not the value of service? Is it not after all the theory of charging what the traffic will bear? So far as these big customers are concerned, perhaps it is, or rather it is not charging what the traffic won't bear, not charging them any more than their costs would be with independent plants, but securing all that their traffic will bear for the reduction of the burden of joint costs to all customers. Now, when we apply this theory to small customers, we are met with the question of regulation, and the answer is this. An electric company, or any public service, must make its rates lower even than they would have been under free competition.

The theory of value of service applies even in this case. The value of electric light service to anyone is not what he would pay a particular company for electric light rather than go without electric light at all, but what he would pay that particular company for the service rather than get an equivalent service in some other way. The value of the service is never above what one of the competitors offers it at, and regulation of prices is merely to determine what the value of the service from the company in question would have been if no monopoly had been granted; in other words, what the company would have charged, in the long run, if subject to competition.

Whenever the return on investment is higher than is reasonable and equitable, competition will naturally spring up, and the authority that grants the monopoly requires that there shall be a reduction of rates, applicable to those classes whose price would have been reduced by means of such competition. Subject to this exception, each price should be such as to produce the greatest amount of business and make the burden of joint costs least; and the final result will be obtained by basing all rates either on actual value of service, or on what this value would be under free competition. This results, in practice, in a simple, general rate such as obtains in most of our cities, with special classifications for power use, and for large customers, etc.

It will be to the interest of owners, as well as of the public, to adjust rates along these lines, and if rates are made public and open to all alike under like conditions, and so long as these conditions are made in good faith and without ulterior motive, any such proper discrimination in rates is justified and should inure to the advantage of the public as a whole. In practice the method here advocated of determining rates works simply, even if it means that the final figure is determined more by the business judgment of the manager, than by the reports of the accountants.

The revision of rates

There are some tests to be applied to any particular revision of rates, that will perhaps make this idea more popular. First, is it a change that would have been produced in the long run by free competition among companies covering the whole territory? If so, it should be made voluntarily by the owner, or, if not so made, should be forced on him. This test, as to what the rates would have been under free competition, is of course a very difficult one for an accountant to apply, but it is not necessary that it should be applied exactly, and in fact, if applied exactly, would not be entirely satisfactory. For instance, free competition in electric service would probably result in low rates in the centers of cities, and high rates in the suburbs, instead of uniform rates. In this case the public probably acts wisely in requiring uinform rates over the territory, but whether it does or not hurts the public more than the owners, so long as the profits are left sufficiently high so as to continue to attract new capital into the field, and into similar fields that to-day appear as risky as the enterprise under discussion looked when it started. Second, is it a change that will produce new business that will furnish some additional contribution to joint costs? If so it should be made in the interests of the business as a whole. Third, is there any other change that will produce a greater contribution towards joint costs?

Now, the answers to these last questions also furnish a test as to whether a rate is discriminating, in the sense in which discrimination is unpopular, because they ask, "does the change produce new business?"

The change in rates may apparently produce some new business, but the business on the new rate may be business that was formerly on the old rate. In such case it is merely a transfer from the old rate, and there is no increase in business, but instead, a decrease in contribution to joint costs, and in such case the new rate does not stand the test. This will often be the case when the customers on the new rate are competitors of those on the old rate. In railroads this

occurs much more frequently than in electric companies. If the rate to Jonesville is lowered that may merely shift business to Jonesville away from Smithtown, without increasing the total. If Smith and Jones are competitors, a low rate to Smith may merely mean that Smith does more business at the expense of Jones, but the total business and the contribution towards joint costs are not increased. If, however, the difference in rates is not between competitors, no business is shifted.

One electric company made a special classification of motors. If this had been General Electric versus Westinghouse, it would have meant merely a transfer from one kind of motor to the other and no new business. Instead, the classification was between elevator motors and ordinary motors, reducing the price to ordinary motors. Here the change brought in more ordinary motors to reduce the burden, but did not affect the business in elevator motors until finally the reduction in joint costs warranted a general reduction which they would not otherwise have obtained. Hence, the discrimination between motors was assumed to be justified in this case.

Even between competitors a differential may still produce new business that is not obtained at the expense of old business. The big store that can put in a plant competes with the small store, but the lower rate to the big store (unless seriously below what it would cost the big store from its own plant) does not hurt the small store. The big store does not, by reason of buying electricity, take any more business from the small store, than it would if the big store had its own plant.

Must discriminate with care

One rate for residences and one rate for stores would never transfer business and would seldom be open to criticism. On the other hand, one rate for two family houses, and another for single houses, might transfer business from one to the other, and in general might be undesirable. One rate for ice making, and another rate for water pumping would almost never transfer business; hence is fully justified. One rate for drug stores and another for saloons, would be apt to transfer business, and would have to be closely scrutinized. One rate for theatres and another for amusement places, would be apt to be discriminating, because it would be apt to transfer business, and a rate for newspaper offices different from ordinary printing offices, would again be subject to suspicion. On the other hand, a rate for hotels might be different from a rate for factories, without much chance of any transfer of business.

The point of making these illustrations is to show how the methods advocated agree with our general ideas. In fact the following is usually a pretty safe guide when considering whether a differential is justified:

If the differential is between customers or classes who compete with each other, the burden of proof should be on those who propose or advocate the differential, and the differential should not be allowed unless it is shown that it is necessary, and no greater than necessary. The differential between large and small customers is of this nature. It is necessary, and in fact it would be better for the small customers, if the differential should be made larger than it is now, so as to get the big users to contribute something towards joints costs instead of nothing, as happens when they do not use the service; but it should always be watched carefully, because any error in adjusting it will merely transfer business from one class to another without really producing any new business.

On the other hand, for a differential between classes which do not compete with each other, the burden of proof should be on those who object to the differential; since, if the classes do not compete, the differential will not transfer any business, and any increase in business will be genuine and for the advantage of all.

The following rules will show how the foregoing methods can and should be applied.

For the company—adjust the rate to the various classes so as to get the greatest volume of business among which to divide joint costs, and in order to do this, first make sure that no class is supplied at a loss, and that each class bears as much as it can contribute (or would have paid under free competition of the joint costs. This means make the rates proportional to the value of the service, less the savings due to monopoly. This should result in a single general rate for the general public, at least as low as would have obtained under free competition. It should result in class rates for power, street lighting, charging of batteries, cooking, etc., lower in many cases than the general rate, and should result in differentials for large customers, all of these class rates and differentials being only as low as necessary in order to get the business. The differentials for large customers should be low enough to get the business now done by isolated plants.

For the public—allow the company to make any change it likes as between customers or classes who do not compete with each other. When a change is proposed that makes a difference between customers or classes that do compete with each other, allow the change only when it is clear that the result will really produce new business, and not merely transfer business as between competitors. When the rates produce more than a fair return, provide for reducing the rates to those classes which would have obtained a reduction if competition had been free.

This is the line along which companies are now developing. The only weak point in their present situation is that they are not making the differentials in favor of large customers (and of certain uses, such as cooking, etc.), enough to get the business, and this requires the small customers to pay more towards joint costs than would be necessary if the rates for big customers were made low enough to shut down every isolated plant, where the owner knew his costs and was not running it for his pride or his amusement.

New Books

Practical Mathematics for the Engineer and Electrician—By Elmer E. Burns and Jos. G. Branch, B.S., M.E.; the Jos. G. Branch Publishing Company, Chicago; price $1.00. It has been the aim of the authors to make this book of value to operating engineers and electricians who have never had the advantage of a college education. The book is elementary, written in simple, clear language and treats only of such subjects as are of special value to all practical workmen; a few simple illustrations.

The Electric Motor and its Practical Operation—By Elmer E. Burns; the Jos. G. Branch Publishing Company, Chicago; price $1.50. The subject of the electric motor has been treated simply and clearly and with so little mathematics that all can understand it. The aim of the book is especially to help the man in the engine rooms and shops to a first hand understanding of motor principles; very clearly illustrated

Alternating Currents Simplified—By Elmer E. Burns. The Jos. Branch Publishing Company, Chicago; price $1.50. This book gives the electrical worker a clear understanding of an alternating current in such a way as to give him a safe and sure foundation for his work. The aim is not a description of the various types of a.c. machinery, but an explanation of principles, in language so simple and clear that the novice can understand it; very well printed and illustrated.

Mr. Jno. P. Fox has begun an investigation of the tramway problems in Montreal, on which he has been engaged by the city to make a report.

ELECTRIC RAILWAYS

The Present Tendency of Street Railway Operating Expenses*

By Mr. J. J. Burleigh

A paper on "The Present Tendency of Street Railway Operating Expenses" might, with a due regard for accuracy, be so condensed as to set forth the answer to the proposition in the single word "upward." Although such a contribution would possess the doubtful merit of brevity, it would be doing no more than stating a fact that is obvious to most, if not all of us. It would be citing an effect without giving the causes therefore, proclaiming a result but throwing no light upon the conditions which produced it. My purpose will be to set out briefly some of the figures and factors which will explain and make clear why the operating expenses have been mounting higher and higher during the past years, and my observations will be based upon the actual experiences of the company with which I have the honor to be connected.

One of the chief reasons why operating expenses have been increasing has been the tendency toward longer hauls for a single 5-cent. fare, due to additional transfer privileges and the extension of fare zones because of the expansion of municipal limits coupled with franchise obligations to carry passengers from any part to any other part of a given city or town reached by a company's lines without extra charge. The growing demands of the public for more service and better service, necessitating more costly equipment and heavier power outlays, has also been a factor. Wages of trainmen and other employees have been increased from time to time, which has added materially to the burdens of operating from a financial point of view and the single item of taxes, including franchise, real and personal, as represented in cash outlay has been nearly doubled on a car-mile or car-hour basis within ten years, making this charge alone an exceedingly heavy toll exacted from the company's gross revenue.

In an endeavor to get at the underlying facts let us subdivide the costs of operating and consider the factors which have been responsible for the increases. We will begin with the maintenance of way and structures. Our experience has been that this item accounted for 1.154 cents per car mile in the year 1904, went to 1.189 cents in 1908, to 1.453 cents in 1909, to 1.888 cents in 1910, to 2.926 cents in 1911 and to 2.999 cents in 1912.

The increases are largely due to a higher wage scale for track and line laborers and an advance in the price of materials used for replacements and repairs. Ten years ago laborers could be hired for 15 cents an hour against a rate of 17½ or 19 cents an hour to-day. This shows an increase of 16 2-3 per cent., and men who are charged with the supervision of this labor declare unequivocally that there has been a diminution of efficiency equal to 25 if not 30 per cent. In other words, the class of men available for this character of work to-day makes it necessary to hire at least four men for every three employed at similar tasks ten years ago. Nor is the end yet, for there is already ground for the belief that a still higher rate of wages will have to be paid with the coming of spring.

Rails, frogs, switches and mates and all other special work chargeable to operation as replacements have gone up in price, as have fishplates, tie rods, bolts and practically everything else which enters into repairs, from 15 to 25 per cent. over the prices of ten years ago, and modern carhouses and concrete roadbeds bring with them certain necessary outlays which must be charged to operating.

Demands in the way of street pavements have grown more exacting and incidentally more costly. Where the relatively inexpensive macadam pavement sufficed formerly it has been superseded, by virtue of franchise obligations, by wood-block or specification granite block which cannot be laid short of approximately four times the cost of macadam. Reduced to a car-mile basis, our experience has shown that street-paving requirements cost 0.172 cent in 1904 and 0.309 cent in 1912, covering a system which includes populous cities, suburban towns and rural communities.

At the same time the cost of bridges has increased, due also to the necessity of providing for the heavier rolling stock, while the rather insignificant item of ties has contributed its share to the general burden of expense. In the past ties were used that cost about 60 cents each, but modern practice dictates the use of cresoted ties at a cost of about $1 each. As they are placed closer together under the heavier girder rails, more of them are required per mile of track. While figures show that the initial cost is many times greater, on a car-mile basis, than formerly, the changed conditions return a measure of compensation in the form of materially longer life of specially treated ties.

Under the head of transportation reference may be again made to the larger and heavier type of cars now used. More energy is consumed in propelling the heavier vehicle, and the car of to-day must be equipped with air brakes as well as hand brakes, unit switch control so that cars may be operated in units or multiples and devices for preventing or minimizing accidents, such as fenders, platform doors or gates and folding steps, all of which have a tendency to increase the cost of maintenance.

Increase in Wages

It is in the item of wages for motormen and conductors and the cost of supervision that larger inroads into a company's revenues may be discerned. In the case of the company with which I am most familiar the cost of wages for trainmen has increased nearly 25 per cent. on a car-hour basis, from 40 cents per hour in 1904 to 49 cents in 1912, and during the same period the cost of supervision has increased as much, if not more, the actual percentages not being readily obtainable because of a rather radical change in the classfication of the account. Under the head of transportation, mention may also be made of the sprinkling of tracks. Where formerly it was deemed sufficient to sprinkle with water many municipalities now insist upon the dust being laid with oil, an operation which has added to operating charges to a measurable degree.

In the item of taxes the street railway company bears its full share of the cost of every public improvement and the governmental outlays of every community in which its property is located besides meeting municipal or state demands in the form of special exactions, or assessments on gross receipts, or in the form of franchise taxes. Higher standards of living and the desire on the part of taxpayers for greater municipal conveniences, better sanitary conditions, more police and fire protection and improved educational facilities all make for increased tax rates and larger tax bills, which must be met from the accumulation of nickels representing rides, so far as the street railway company is concerned. When to all these is added an increasing fran-

*Presented at Conference of American Railway Association.

chise tax on gross receipts, as has been the situation with which we have been confronted, it is easily understandable that the burden of taxation has been growing no lighter as the years have gone by.

To state the facts concretely let me say that in 1904 the taxes paid by the company the writer represents amounted to 5.12 per cent. of the total operating revenue; the cost per car mile was 1.301 cents and the cost per car hour was 11 cents. Growing in volume each year, the corresponding figures for 1912 were 7.12 per cent., 2.226 cents and 19 cents respectively. Here figures are more eloquent and more illuminating than words.

One other source of expense properly chargeable to operating is worthy of consideration. It is one that had its inception in the comparatively recent past and yet has assumed sizable proportions. It concerns the employees and working conditions and may be designated by the word welfare. Distinct from the requirements of a legislative enactment known as an employers' liability and workmen's compensation law, in force in our State, the welfare work of the company with which the writer is connected comprehends sick benefits, life insurance and pensions paid voluntarily by the company without contributions on the part of the employees. Started in 1911, the cost of these beneficial features amounted in the aggregate to $20,320, or the equivalent of 0.063 cent per car mile, while for the year just ended the outlay had grown to $37,757, or 0.08 cent per car mile. This was in addition to other minor outlays for the promotion of social functions, dinners, entertainments, smokers, outings and inter-division baseball league of twenty teams, pool tournaments and other games and contests for the benefit of the trainmen and members of their families. The workmen's compensation act above alluded to called for an expenditure, in addition to all of the foregoing, of something like $27,000 during the first twelve months it was in force.

With these observations, treating as they do of only some of the elements of operating costs and substantiated, I dare say, by the practical experience of every man actively engaged in the industry, it is not difficult to see "The Present Tendency of Street Railway Operating Expenses."

Our problem is to bring the facts home to the public, to the municipal authorities and to the state legislatures so that they, too, will see and be convinced that there is a limit beyond which the street railway cannot go and still fulfil, in an efficient manner, the purpose for which it was created; that the burdens cannot be made too heavy without curtailing its sphere of usefulness or retarding its efforts as an upbuilder and developer of the communities it serves.

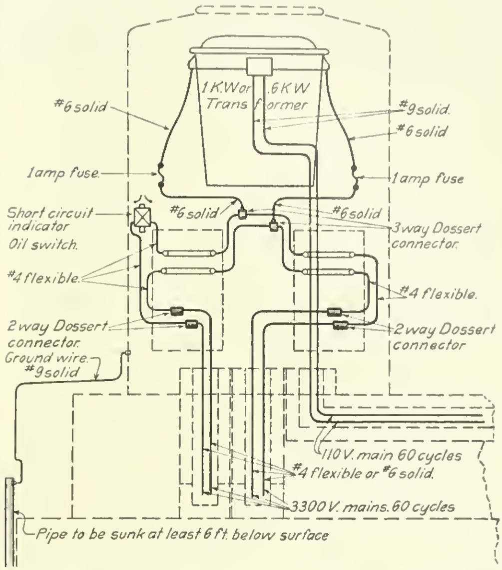
Cape Breton Electric Company

During the coming summer the Cape Breton Electric Company, which operates the Sydney & Glace Bay electric railway, will construct a sub-station for distributing railway current at a point on the Glace Bay division known as Reserve Junction. This sub-station will contain two 250-kw. step-down transformers furnishing 2200 volt, 2-phase, 60-cycle current to a 300 kw. motor-generator.

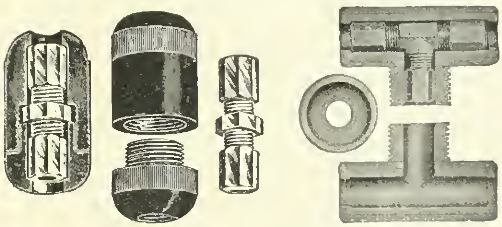
A 10-mile transmission line will be built from the power station at Sydney to the above sub-station. This will be 22,000 volt, 3-phase. For supplying this line, an additional bank consisting of two 250 kw., 2200 volt, 2-phase to 22,000 volts, 3-phase transformers will be installed. This latter bank of transformers will operate in parallel with a bank at present supplying 22,000 volt current for the company's transmission line to North Sydney. Included in the above work will also be the necessary switching equipment in both the Sydney power station and the reserve sub-station. The extension work will be under the supervision of Mr. E. L. Milliken, manager.

Dossert Connectors in Signal Work

The accompanying illustrations represent a typical installation by the signal department of a trunk line railway and show the application of Dossert connectors to the wiring of a 3300 volt transformer and sectionalizing case. The three-way connectors are used in connecting up the primary leads across a 3300 volt main and the two-way connectors are used



Plan of Wiring of 3,300-Volt Transformer and Sectionalizing Case. Showing Application of Dossert Connectors



Types of Two and Three Way Connectors, Showing Detail and Insulating Covers

in the mains themselves at the point indicated in the wiring diagram.

The Dossert two-way and three-way connectors and the method of application of each type are shown in the bottom illustrations. The two-way connector may be applied to stranded cable or to solid and single strand wires. The three-way connector is similar in form and application to the other. Insulating covers are available for both types.

Quebec Rapid Transit

The Bill of the Quebec Rapid Transit Railway Company has been before the Railway Committee at Ottawa. The new company has a capital stock of one million dollars, and head office is in the city of Quebec. It is proposed to construct an electric tramway from Quebec to the Isle of Orleans, and to construct a bridge from the north shore of the St. Lawrence to the island. A couple of branch lines are provided. The committee adjourned the consideration of the bill with a view to changes being made.

Illumination

The Production of Artificial Daylight

By Allan B. Wearing, A.M.I.E.E.

In the following article it is not intended to deal with the lighting of rooms in private houses, but with the illumination of large premises, such as stores and factories, more particularly where a color true light is indispensable, though the general principle of what is stated applies to all forms of artificial lighting. The claim is made by the writer that an indirect or semi-indirect system using arc lamps as the source of illumination is best suited for these conditions.

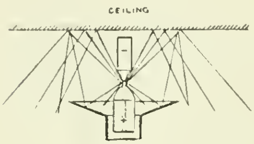


Fig. 1

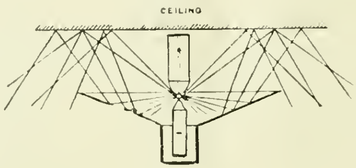


Fig. 2

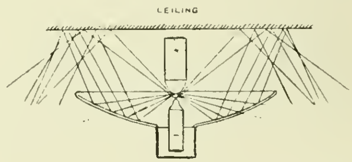


Fig. 3

Illuminating engineers are all aiming for the ideal artificial light which may be described briefly as resembling **bright diffused daylight** such as may be obtained in a suitably proportioned and well-lighted room facing a northern sky. Unfortunately many manufacturers did not originally study the comfort of the eyes, and they failed to recognize the fact that eye-strain must follow the use of systems which are not conducted on strictly healthful lines, while too much attention has been paid to the efficiency of the light source and its selling properties for profit making. The general public, however, owing to the efforts of illuminating engineers and opticians, are at last finding out that eye-protection they must have, and they will no longer submit their eyesight to harmful direct rays that damage the sensitive retina of the eyes and also seriously affect the nervous system. More recently, however, the manufacturer is working in direct harmony with the laws of nature and it is one of the objects of the present article to give a few examples of the **"daylight"** system of lighting, as practiced by the Canadian Union Electric Company, Limited, and which as nearly as possible gives the ideal "diffused daylight effect" at night.

This system is not in reality a new one as it has been generally installed all over the world, and is daily gaining in popularity on account of its efficiency and the hygienic conditions surrounding its use; but it may be a new system to many readers in this part of the world, and as such will be interesting owing to the fact that modern arc lamps are used as superseding metal filament lamps and because of the higher efficiency and better quality of the light.

For ideal light which gives perfect comfort to the eyes there are two essentials—**diffused light** and **daylight quality.**

Diffusion may be produced in two ways—refraction-obstruction, and reflection. Refraction-obstruction is the most familiar (and most wasteful) method. A general example is that of an incandescent lamp enclosed in a semi-transparent globe which probably absorbs about 50 per cent. of the original light. Reflection is now generally recognized as the best method of diffusion and is the principle that has been adopted in the indirect and semi-indirect lighting system by arc lamps, which is described below.

The Union **"daylight"** system of indirect arc lighting is carried out in any of three ways, all of them involving the basic principle of shielding the eyes from **direct rays** and of illuminating entirely (or almost entirely) **by reflected light.** The three methods are known respectively as follows: (a) the inverted method, Fig. 1; (b) the indirect method, Fig. 2; (c) the semi-indirect method, Fig. 3. The three diagrams give a rough idea of the distribution of the light-rays in each method and will be easily understood.

(a) In the inverted method the carbons of the arc lamp are inverted so as to project the light upwards to a white ceiling from which the light is reflected and evenly diffused

Fig. 4

downwards over a large area; a small under reflector shields the eyes from direct rays.

(b) In the indirect method the light rays are projected downwards and are thrown back to the ceiling from an opaque under-reflector.

(c) The semi-indirect method is similar to the indirect but some of the light passes through a semi-transparent under-reflector.

Each method has been designed to suit different conditions occurring in practice, but it is not here necessary to go into technical details. A good idea of the results obtained is seen from the accompanying illustration, Fig. 4, which shows a very equal diffusion resembling the definition given above of the ideal light.

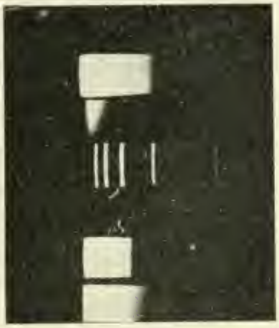


Fig. 5—Spectrum of daylight compared with Tungsten lamp Mercury arc lamp, Carbon arc lamp with globe and Carbon arc without globe

Daylight Quality of Light as Shown by the Spectrum

Daylight is not harmful to the eyes and, therefore, an artificial illuminant that most nearly resembles it is the best from the hygienic point of view. In a recently published series of experiments made by a prominent association in the quest of artificial daylight the following results are reported:—

Artificial daylight was obtained by using a screen of three different colored glasses with a metal filament lamp as the light source. The ideal absorbing screen had a transmission of about 15 per cent. The specific consumption was about 10 to 12 watts per candle. These experiments are extremely valuable in showing the serious loss in efficiency by using this method of substractive production of artificial daylight.

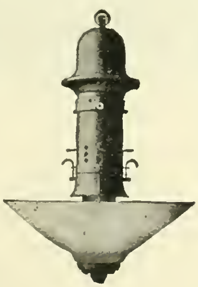


Fig. 6

Let us now consider the spectrum—the recognized test which gives us the true comparison between daylight and artificial light. The illustration herewith, Fig. 5, is an exact reproduction of various spectra, obtained photographically, viz., daylight, compared with tungsten lamp (naked), mercury arc, carbon arc (with diffusing special globe), and carbon arc (naked). The spectra were taken under exactly equal conditions with equal photographic exposures and for equal photometric intensities. The reader will notice that the two carbon arc lamp spectra, in the illustration, very nearly resemble that of daylight, and consequently when the light is reflected and screened from the eyes, as shown in the "daylight" system of illumination, the result and effect is the ideal artificial light as defined at the beginning of the article

The only point now remaining is that of efficiency, and fortunately not much is lost in substractive transmission or reflection. If the coefficient of reflection of the ceiling is poor an over-reflector of high reflective value is subsituted with excellent results, and, while it gathers no dust, is easily cleaned. The efficiency of these lamps, therefore, is remarkably good and in the illumination of several large interiors the cost has proved to be little more than half that of ordinary lighting by metal filament lamps. Fig. 6 shows a standard type of arc.

This system of lighting should be most valuable in all department stores, textile mills and factories—in short—all places where daylight illumination is required that is color-true in all respects. For some years past in Europe and Great Britain there has been an arc lamp on the market especially designed for color matching, the custom being to take the goods under the lamp to obtain daylight conditions. The fact that similar lamps are still being placed on the market accentuates the point that the ordinary form of incandescent lighting is not suitable for color matching, and that a substitute is necessary. The system described above obviates the necessity for any such installation in that the whole premises is now illuminated by artificial daylight.

Trial of Ornamental Arcs in Vancouver

Early in January a temporary installation of "G.E." ornamental magnetite luminous arc lamps was made by the city of Vancouver, when the superiority of this class of street lighting over the ornamental incandescent system of lighting, at present in use on the principal thoroughfares of the city, was clearly demonstrated. This installation was made on South Granville street, between Ninth and Tenth avenues, and consisted of six brackets attached to trolley poles, and one ornamental standard placed at the corner of Tenth avenue and Granville street. Each standard, or bracket bears only one arc light.

This ornamental luminous arc lamp is known as the Great White Way type. It consumes approximately 510 watts, and an efficiency of .79 watts per mean spherical candle-power is attained. The lower electrode is in the form of a tube filled with a composition containing magnetite, and has a life of approximately 150 hours. The trimming operations are very simple. Only one electrode is required at each trim. The globe breakage is reduced to a minimum because the globe is large and away from the arc; also its removal for cleaning is unnecessary, and hot particles cannot drop on it. The simplicity and durability of the lamp assure relaibility and economy of maintenance The large amount of illumination also renders possible their installation with a spacing of twice the distance maintained in connection with any other system of ornamental street lighting. The poles are easily installed as they have a minimum number of pieces to assemble, all goosenecks, mast arms, cross arms, etc., being eliminated. By using direct current through a rectifier system the line loss is greatly reduced; for example, if alternating current is used, the watts loss per 1,000 feet of single conductor cable will be about double the loss with direct current of the same amperage. As may be seen from the accompanying illustrations, the lighting units are of simple yet effective design, and enhance the appearance of a street by day, as well as by night

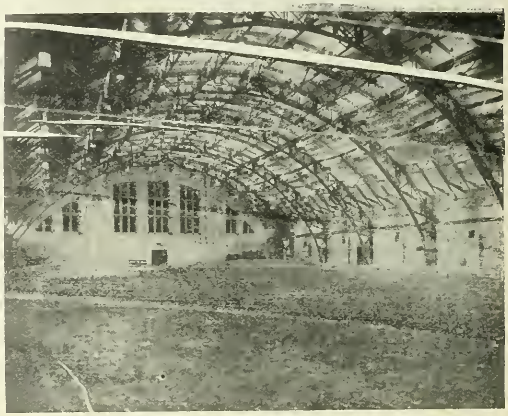
The lighting system here described is the latest development in the science of street illumination, and its successful trial at Vancouver marks its first appearance at the coast. The demonstration has been most favorably commented upon by every one who viewed the trial lighting. The city authorities were enabled to make the necessary tests through the co-operation of the B. C. Electric Railway Company, who carried out the necessary line work, and also placed the trolley poles on South Granville street at the disposal of the city electrician during the period of the trial installation.

Type of arc lamps being tried out in Vancouver. Note lamps in distance attached to wooden poles

The success of the new lighting system is evidenced by the fact that the Fourth Avenue Ratepayers' Association have instructed the city electrician to install ornamental luminous arc lamps on that thoroughfare, between Granville street and Alma Road, a distance of about two miles. This will necessitate the use of 200 of these arcs, and will effect a noteworthy improvement in the illumination of this district. The city electrician has recommended that the light brackets be placed on the steel trolley poles of the B. C. Electric Railway, thereby reducing the multiplicity of poles which would be required if ornamental standards were adopted. The property owners on Broadway have also expressed themselves in favor of the new lighting system, and it is probable that an installation will be shortly made on this thoroughfare, similar to that which has been proposed for Fourth avenue.

Fine Results With X-Ray Reflectors

The two illustrations shown herewith portray installations of X-Ray bee-hive reflectors recently installed in two buildings of the Northwestern University at Evanston, Ill., one in the gymnasium and the other in the swimming pool. These photographs were made solely by the light from the lamps and reflectors, being taken at night and no flashlight or other extra source of light being used The resulting even illumination obtained by using these scientifically designed reflectors is very simple. In the gymnasium where baseball practice and similar games are indulged in, it was necessary to obtain a "sky" effect and this was arrived at by inverting X-Ray reflectors above the girders with the results shown. Perhaps the most important point in this installation is that unless one stands directly under one of the reflectors and looks straight upward, not a single light source can be seen. The reflectors themselves are concealed in fixtures designed to be in keeping with the ornamental scheme of the building. The gymnasium room is 129 ft. by 193 ft., and the arched roof is 50 ft. high at the centre.



A properly lighted gymnasium

The swimming pool photograph was also taken at night without the aid of any other light. The opaque bee-hive reflectors here used are contained in the ornamental fixtures shown, and a few additional small lights are also introduced to give life to the fixtures. The distinctness with which the bottom of the tank can be seen is very noticeable as is also the agreeable absence of glare.

Swimming pool—Reflectors in ornamental fixtures

The nineteenth annual meeting of the National Fire Protection Association will be held on March 26th and 27th, 123 William street, New York City, when reports and suggestions for changes in the National Electrical Code will be considered. Advance copies of the committee reports on suggested changes have been sent out. The suggestions are numerous, but do not appear to indicate any very radical changes in the existing code. The National Code is revised every two years and attention is called to the fact that the next revision will not be till 1915

The Dealer and Contractor

The Retail Dealer and Electric Appliance Sales

To collect information useful to the whole industry on the subject of electric-appliance sales and present conditions in the trade, the Electrical World recently mailed letters of inquiry to a large number of retail dealers and contractors. The list included cities and towns of various sizes in every state and section of the country, thus insuring not only thoroughly national representation in the opinions expressed but the reflection as well of the views held in both large and small communities.

The questions asked are given below, together with a tabulation of the replies received from the dealers. Frank statements in reply were encouraged by assurance that the individual sources of the comment and information received would be treated with all confidence.

As set down in the following paragraphs, the replies received from 424 representative retailers who answered have been carefully classified and analyzed, in the belief that effective light may thus be shed on present conditions in the electrical trade and the readjustment needed to place trade relations on a more stable basis.

In answer to the first question, relating to the device most satisfactory to retail, the replies were, as might be expected, overwhelming in favor of the electric iron. Of the total number, 304 gave the iron first place, the next place being given the electric toaster with 36 votes. Other appliances receiving mention were as follows: Motors, 25; vacuum cleaners, 20; electric fans, 18; lamps, 15; washing machines, 14; electric stoves, 13; percolators, 7; warming pads, 6; radiators, 3; curling irons, 1. Similar estimates of the relative values of other appliances besides irons were afforded by the replies to the fourth question.

The greatest difficulty met by the retailers in building up a profitable flatiron business, according to the results of the canvass, seems to lie in the activity of central stations in selling devices at cost or even below cost in order to further the consumption of electricity. Some of the comment received from dealers on this policy of the central station was particularly bitter and indicates that the ill feeling engendered between local branches of the industry may embarrass other relations essential to the development and prosperity of both parties.

As one correspondent pointedly asserted, the customer quite naturally expects that the central station will prefer to sell him a device that consumes a large amount of electricity and he is not to be blamed if he at once suspects any price cutting which can be attributed to this motive. From the dealer, however, who has no further interest than the sale of appliances and the making of a satisfied customer, the purchaser expects unbiased advice; and later, feeling that he is getting an economical, efficient iron, he will have no fear about making liberal use of it.

In a case cited by the writer already quoted the central station a year ago gave away, absolutely free, 200 irons. When the first month's bills came to these 200 users the increases evident caused much dissatisfaction and criticism of the company's intentions in giving away the irons. Even now the customers who kept the free irons, according to the correspondent, do not use them nearly so much as they might have done had they bought the irons in the first place. "We know," writes one contractor, "that the electrical dealer can sell heating and cooking devices more easily than a central station, and the only reason for this is that the consumer knows (or at least he thinks) that if he purchases from a dealer he is getting a device that will consume the least amount of energy."

Cheap and consequently poorly constructed irons, such as are sold by the department stores and hardware dealers, are also credited with injuring the legitimate business of electrical supply dealers. The low price at which these goods can be profitably sold embarrasses the dealer with a first-class article and, later, the poor service given by the cheap iron destroys confidence in electrical devices in general. Several correspondents also cited the central-station rate for electricity as being too high for the economical operation of irons.

Guarantees too Generous

The generous guarantees proffered by certain manufacturers seem to be another difficulty in the way of the small dealer, whose margin of profit is already pared to the livable limit by sale conditions. The iron itself may be injury-proof, but such incidents as blown fuses, broken cords, etc., which follow in the wake of its installation sometimes prove expensive to the local dealer, on whom the customer depends to make good the sweeping guarantees of the maker. Blowing of fuses caused by the extra current demand of the irons, breaking of cords, attachment plugs, etc., are all accidents which, although clearly outside the makers' guarantee, cannot be so easily explained away to the customer's satisfaction, nor can he be convinced that he should pay the cost of sending a man to make such repairs. Rather than argue his position as to the extent covered by the guarantee, the dealer sustains the cost of the repairs and thus absorbs his own profit.

While a number of dealers flatly insist that they have received "no assistance of any kind" in furthering their iron and apparatus sales, the majority stand ready to admit that the advertising done by the manufacturers has awakened the public's interest in the use of electric devices. The answers received to the sixth query, however, show that, in an overwhelming proportion of cases—277, in fact—the customer enters the store and asks simply for "an electric iron," leaving the selection to the dealers' judgment and experience. Only seventy-one dealers reported that their customers demanded a special make of iron as the result of national and local popular advertising. Thirty-five others traced the demand for a particular brand to the customer's previous experience with the same make or the advice of a friend. In at least six places from which responses were received local pride in a nearby electrical factory controlled the choice of

purchase. Many of the dealers reported that their own advertising in local papers was especially effective, although they profited also from the campaigns conducted by the central station. Others insisted that for their greatest assistance in making sales they depended upon the efforts of their own salesmen and their display windows. Satisfied customers and free trials of the apparatus were also cited as useful factors. In the language of the dealers themselves,—"Customers rarely ask for a particular make and can be easily influenced from one to another by the salesmen." "The choice of the iron purchased is usually left to the dealer's judgment." "Most customers want the iron the dealer recommends." "Few laymen know that there is any difference in electrical devices."

Replies Received From Dealers in Electrical Devices

1. Q.—What energy consuming device is the most satisfactory to retail? A.—Electric irons, 304; toasters, 36; motors, 25; vacuum cleaners, 20; fans, 18; washing machines, 14, etc.

2. Q.—What is the greatest difficulty, if any, you are meeting in building up a profitable flatiron business? A.—Cutting of prices by central stations to cost and below cost. Competition from poorly constructed and cheap devices. Unlimited guarantees of manufacturers.

3. Q.—What is the greatest assistance you are receiving in building up flatiron business or sales of other devices? A.—Assistance of manufacturers, general and local advertising. Dealers' sales effort and advertising. Central station activity. Window and store exhibits. Also complaints of "no assistance from any source."

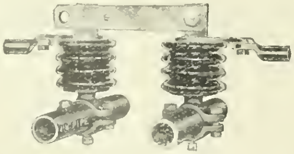
4. Q.—What electric heating or cooking devices, besides flatirons, do you find it most profitable to retail? A.—Toasters; percolators; electric ranges; luminous radiators; grills; stoves.

5. Q.—Are you actively promoting the sale of any one line, or are you carrying in stock various makes of electrical devices? A.—Carrying only single line, 122; various makes, 265.

6. Q.—Do you find that most customers ask merely for "electric irons," or is there a demand for some one make? If there is a decided preference for a particular make, to what do you attribute this demand? A.—Ask for merely "electric irons," 277. Demand special make, owing to popular advertising, 71; owing to previous experience, quality, etc., 35.

A New Idea in Disconnecting Switches

It has been the general practice among manufacturers of disconnecting switches to use the single blade idea in connection with the familiar sweated and pinned clip construction. Users of switches built in this manner acknowledge that the inherent weakness of a switch made thus is the probability of the clips not making good contact with the blade, if the switch should heat sufficiently to melt the solder, thus



causing the switch to heat still further, due to reduced contact surface area.

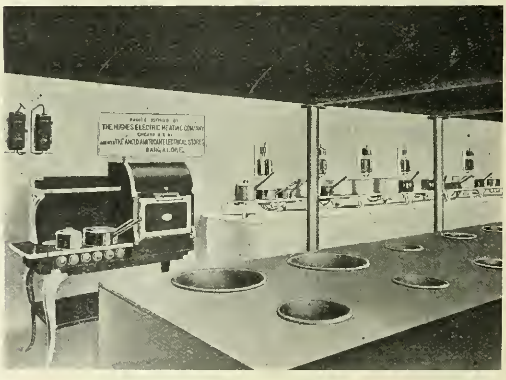
With the idea of surmounting such difficulties, a new line of switches has been designed in which the usual pair of clips is supplanted by a solid copper tongue, cast integral with the switch top. This tongue is milled so as to receive the two blades, which are made of the proper carrying capacity, and separated such a distance as to allow of their being firmly closed over the tongue, one on either side The blades are equipped with take-ups, so as to compensate for wear on both the tongue and blades. This is shown in the illustration herewith, this switch being a 6,600 volt, 300 ampere type, for 1¼ in. pipe mounting.

Another interesting feature of construction is the absence of the usual unsightly clamps used to fasten the switch tops and bottoms to the porcelain. It will be noted from the cut that these parts are so designed as to materially add to the appearance of the switch, the method of rigidly anchoring them to the porcelain being an original, patented idea. All contact surfaces, current conducting parts, and other essential dimensions are very liberally designed, the paramount idea being to give such a margin of safety that as the station capacity increases, no fear need be felt as to their successful operation.

This style of switch construction has been standardized and a complete line is available, varying in capacity from 300 amperes to 2,000 amperes, and from 2,500 volts to 33,000 volts, for either pipe or flat steel base mounting, using corrugated porcelains or line insulators as may be desired. A decided advantage in such a construction lies in its being more rugged and simpler, and that it lends itself to the use of a locking device which becomes an integral part of the blade construction, being built in between the two blades, thus contributing further to the idea of simplicity. The locking device is a very ingenious patented idea, being so constructed that only a single operation of a standard switch hook is required to both release the lock and open the switch. The design, workmanship, material and finish of this switch are claimed to be the best possible. It is manufactured by the Electrical Engineers Equipment Company.

The Maharajah Adopts Electricity

The accompanying illustration represents an installation of electrical equipment recently made by the Hughes Electric Heating Company in the kitchen of the Palace of the



Maharajah of Mysore, India. The holes in the foreground are of the charcoal stoves that were used previously to the installation of electric ranges. The electric equipment consists of the following: Six 3-burner hot plates, four 2-burner hot plates, one cabinet range, two table stoves, six self-contained ovens. This installation has added interest from the fact that chief electrical engineer to the Government of Mysore is Mr. C. F. Beames, formerly manager of the Nipissing Central Railway Company.

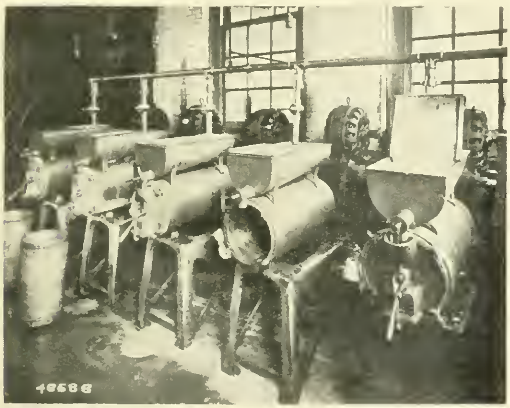
The Canadian Puget Sound Lumber Company have made arrangements to take power from the B. C. E. R. Co. up to 1200 h.p. for their mill in Victoria.

The Application of Electricity to Ice Cream Making

In the scientific manufacture of ice cream in large quantities, electricity is now used very extensively. In a large Philadelphia plant with a capacity to serve 100,000 people a day, that is, say 10,000 quarts of ice cream, a total of seventeen motors with an aggregate capacity of 140 h.p. have been installed. Most of these motors are used for refrigerating purposes, no ice being used except for the preservation of the ice cream in its frozen state during its transportation from the factory to the consumer.

The refrigeration in this plant is produced by a 30-ton refrigerating machine connected by chain drive to a 60 h.p. induction motor. The cream is brought to the factory in sterilized cans, is pasteurized and then forced through slow cooling coils until it reaches the proper temperature, when it is automatically delivered to a silver lined mixing machine. Into this same machine are also poured the other necessary ingredients, including sugar and fruits. This mixture is now thoroughly mixed, the operation being performed by a 10 h.p. motor which also drives the cooling apparatus.

After mixing, the prepared cream is again forced through a series of cooling coils and passed at its decreased temperature into the six 40-quart individual German-silver lined freezing machines shown in the figure. Each of these machines is driven by a 3-h.p. induction motor. The cylindrical freezer is surrounded by a brine jacket, the brine being kept in constant circulation by a pump driven by a 10-h.p. motor. When the cream reaches a consistency which will just permit of its being poured, it is drawn out of the freezers into



ice cream cans. The temperature in this latter case is judged by the consistency of the mixture, which is again judged by the amount of current the motor performing the mixing is using. So it is that an ampere meter tells indirectly the temperature of the cream. Electric motors are also used to drive can washers, sterilizers, ice crushers, pumps, elevators and fans. The economy of electrical operation in the manufacture of ice cream over the old fashioned methods is claimed to be very great, to say nothing of the greatly improved sanitary conditions which result from the use of electric drive.

Will Represent Keystone Co.

On and after March 1st, 1913, the old-established house of Surpless, Dunn & Company, of New York and Chicago, will be the direct representatives of The Keystone Manufacturing Company, Buffalo, N.Y., manufacturers of Keystone and Monarch Ratchets, Westcott Wrenches, etc.

New Condulets

Fig. 1 shown herewith represents the type FBL condulet which has been designed by the Crouse-Hinds Company of Canada to meet the requirements of the Association of Railway Electrical Engineers calling for a suitable device to accommodate a 100 to 200 ampere fuse for battery circuits on electrically lighted cars. These condulets are of substantial design and well suited to meet the most severe service. Each is provided with a close fitting, hinged cover with catch, which protects the contents of the condulet from dust and bad

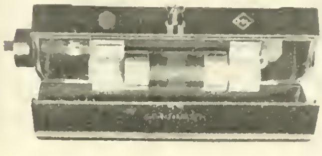


Fig. 1

Fig. 2

weather. In connection with this condulet there is also an adjustable fuse holder for use when it is desired to mount an open link instead of an enclosed fuse. This type of condulet has been specified by the C. P. R. Company for use on their cars now being built by Barney & Smith, of Dayton, Ohio.

Fig. 2 represents type TJ condulet for use with telephone jacks and is especially designed for making telephone connections at railway stations. The condulet has a swivel base which is secured to the under side of the car, allowing the body of the condulet to swing around in such a manner that the telephone plug will pull out when the car leaves the station. A hinged drop at one end falls by gravity when the plug is removed and closes the opening into the condulet. An insulating bushing is provided at the opposite end through which the telephone wires pass to the interior of the car. The telephone jack is secured to the inner side of the condulet cover; therefore, to take out the jack it is only necessary to remove the two cover screws, which also gives access to the condulet.

The Crouse-Hinds Company of Canada have also just issued a special bulletin on panels and cabinets specially designed for 250 to 500 volt, Edison three wire systems with grounded neutral.

The Jefferson Glass Co.

From "sand" to "Luceo" and "Moonstone"—this is the story of the magic transformation that is constantly taking place in the factory of the Jefferson Glass Company, Gerrard St. and Carlaw Ave., Toronto. This factory has only been in full operation for about three months and already every department has settled down to that steady routine which guarantees quality and prompt delivery to the customer. Every equipment essential in the manufacture of the various kinds of useful and ornamental glass has been provided and though, of course, the chief product will be reflectors, globes, etc., for use in electric lighting installations, other forms of glassware are also included. One of the most important sections of the factory is that given over to the manufacture of the numerous moulds required. This section is specially valuable in view of individual requirements of architects or others who may require a special design for any particular installation. This department of the Jefferson Glass Company will manufacture to the specifications of the customer any design of mould required, thus giving to his particular installation an individuality it would be impossible to obtain by purchasing equipment in the ordinary way.

Annual Company Conventions

As indicating methods adopted by one successful business house in handling their sales problems, the following information will doubtless be of interest to our readers:—

Following a long established custom, the salesmen, as well as the department managers, of the H. W. Johns-Manville Company, assembled in annual convention on various dates from January 2nd to February 8th, at Milwaukee, Boston, New York, Philadelphia, Pittsburgh, Cleveland, Chicago, St. Louis, New Orleans, San Francisco, and Toronto, to learn more about the products they sell. One by one about three hundred products of this concern, such as J-M asbestos roofing, shingles, packings, pipe coverings, brake linings, conduit, waterproofing materials, mastic, cold storage insulation, electrical supplies, etc., were taken up and their advantages over competitive products pointed out to the salesmen by specialists in each line. A week's time was devoted to each of these conventions, with a banquet at the close as a fitting ending.

Installing McDougall Pumps

The city of Montreal has awarded to The John McDougall Caledonian Iron Works Company, Limited, of Montreal, a contract for two twelve million Imperial gallon pumping units, at a price of $50,046. The units consist of two 20-inch three-stage Worthington turbine pumps, direct-connected to 750 brake horse-power Browett-Lindley high speed engines, running at 350 r.p.m. and operating against a water pressure of 92 pounds. The three-stage pump of the McDougall company was selected as a type that already had given the city very satisfactory service for a number of years, operating 24 hours per day. This makes the thirteenth pumping unit furnished to the city of Montreal by the John McDougall Company and Henry R. Worthington, aggregating a total pumping capacity of over one hundred million Imperial gallons.

Chapman & Walker in New Building

Chapman & Walker, Limited, electrical engineers and contractors, are now leaving their present premises at 69 Victoria street, and moving into their new building at 118-120 Richmond street west, Toronto. This move has been made necessary by the constantly increasing business this firm is doing. In their new building, which was designed by Messrs. Chapwick & Beckett, they have a showroom displaying all kinds of electrical machinery and fixtures, with large offices at the back. The warehouse is situated in the basement. The freight elevator has been installed by the Otis-Fensom Elevator Works of Galt, Ont.

Messrs. Chapman & Walker hope to be settled in their new building within the next fortnight.

The Hinton Electric Company

An important change recently took place in the Vancouver management of the Hinton Electric Company of Victoria. Mr. J. A. Hinton, who has for years been prominently identified with the commercial life of the capital city, and who is president of the Hinton Electric Company, has taken charge of the local establishment. The company is one of the oldest and most reliable firms in British Columbia, and the presence of Mr. Hinton at the head of affairs ensures continued expansion and progression in its internal affairs.

Escher, Wyss & Company, [illegible], have received a contract for a pump for the city of [illegible] waterworks system, which will have a capacity of [illegible] gallons per day. The pump will be driven by a [illegible] horse-power [illegible] Corliss and Morcom engine. The contract price for the entire equipment is $16,000.

Trade Publication

P. & S. Bulletin.—No. 766, showing how it is possible to make 24 P. & S. sockets from fifteen parts.

Pneumatic Tools.—Bulletin No. 124 issued by the Chicago Pneumatic Tool Company, describing their new pneumatic riveting, chipping, calking and stone hammers.

Dossert Connectors.—A reprint from the Signal Engineer of an article on the use of Dossert Connectors in signal work, distributed by Dossert & Company, New York.

Reflectors and Fixtures.—Bulletin I-T, descriptive of Wheeler industrial reflectors and Mazda fixtures for mill and factory lighting, issued by the Canadian General Electric Company.

Greatest Efficiency.—Booklet issued by the National X-Ray Reflector Company, of Chicago and New York, describing their reflectors as being typical of greatest efficiency in reflection of light.

Commutator Cement.—A booklet issued by the Westinghouse Electric & Manufacturing Company, describing a commutator cement for repairing pitted commutators and for filling slots of undercut commutators.

Proper Lamp Voltages.—A discussion of the selection of incandescent lamps for use on circuits having a fluctuating voltage, issued by the engineering department of the National Electric Lamp Association, Cleveland.

L'Ecole Polytechnique.—Bulletin No. 1 issued by L'Ecole Polytechnique of Montreal, describing the operations of that school. Some interesting articles on technical subjects such the "metric system" are included in this number which is published in French.

Railway Operation.—A booklet issued by the Canadian Westinghouse Company, entitled "Economy in Railway Operation." The article is written by Mr. F. E. Wynne, and is a reprint of a paper read before the Baltimore section of the American Institute of Electrical Engineers.

Electric Specialties.—1913 catalogue just issued by the McGill Manufacturing Company, Valparaiso, Ind. This company manufactures electric specialties of all kinds including the well-known Loxon lamp guard, thumswitch trouble finder, lamp frosting fluids, adaptable lamp changer, etc.

Spring Binding Post.—Catalogue No. 1 issued by the Fahnestock Electric Company, Brooklyn, N.Y., descriptive of the spring binding post manufactured by this company. It is claimed that these binding posts are more rapid in their action than other types, make better contact, offer less resistance and require no tools.

Fuel Economies.—A catalogue issued by G. L. Simonds & Company, Chicago, describing the Simonds fuel economy lines. These lines include the Vulcan soot cleaner for water tube and fire tube boilers, the Hays flue gas analysis instrument, the Dean boiler tube cleaner and the Eclipse smoke indicator. This book is a practical treatise on fuel economy in connection with power plant operation.

Electric Power Transmission.—A booklet issued by the British Aluminium Company, outlining the advantages possessed by aluminium over copper in transmission work. A study has been made of the economic and technical aspects of the use of aluminium as a transmission line conductor, and in making comparisons with copper, it is believed that every possible factor influencing the cost has been considered.

Small Motors.—Booklet issued by the Canadian Westinghouse Company, entitled "How Westinghouse Small Motors can Help you." The pamphlet contains suggestions for saving time and labor in homes, hotels, restaurants, offices, stores, shops and on the farm. The same company has also issued a similar booklet entitled "Westinghouse Motors"; this booklet is specially designed to emphasize the fact of the serviceability of motors manufactured by this company.

Current News and Notes

Aurora, Ont.

Professor Herdt of McGill has been engaged by the Town Council of Aurora, Ont., to advise on the power propositions submitted by the Hydro-Electric Commission and the Toronto and York Radial Railway Company.

Brandon, Man.

The new street cars are expected to arrive not later than March 1st.

Chatham, Ont.

It is reported that Mackenzie & Mann interests have purchased the controlling interest in the Chatham, Wallaceburg and Lake Erie Railway Company.

Fort William, Ont.

Manager Farquharson, of the light and power department, advocates the sale of power for electric cooking purposes at the reduced rate of $1\frac{1}{2}$c per kw. hour. The present rate for this purpose is 3c per kw.h., but it is argued that any extra current sold at the off-peak hours would be clear gain. The only difficulty that might arise would be the increase of the peak load by the introduction of a large number of cooking appliances.

Fredericton, N.B.

There are reports that the Fredericton Street Railway Company who secured a charter for a street railway system here three years ago, are reviving the question, and that there is a possibility of the road being built at no very distant date.

Galt, Ont.

The first annual report of the Waterloo Township Municipal Telephone Association shows that the trunk line covers 43 miles, has 250 subscribers and that the cost per phone is approximately $6. The system will be extended to the west side of the Grand River and also to New Germany, and probably to Woolwich township. When these extensions are complete it is expected that the system will include five hundred subscribers.

Glencoe, Ont.

An hydro-electric system is planned, power to be taken from the Hydro-electric Commission of Ontario.

Guelph, Ont.

The matter of the purchase of some new cars for the Guelph railway system was recently discussed by the Board of Management. It was the general opinion that new cars will be required during the coming summer, and it is reported a by-law may be submitted for authority to raise the necessary funds.

Halifax, N.S.

In the speech from the throne at the opening of the Nova Scotia legislature, it was forecasted that a grant would be made this session for the construction of rural telephone lines.

Hamilton, Ont.

Tenders will be called shortly for equipment for transformer station.

The Board of Control has ordered new plans to be prepared for the electric pumping station. Building, complete with equipment, will cost $70,000. Pumps and motors required.

London, Ont.

It has been announced that three new hydro-electric distribution lines will be built out from this city during the next summer to serve that number of agricultural districts and the towns and villages therein.

Street lighting extensions to the number of approximately 270 lights will be installed in the outlying sections in the near future.

Montreal, Que.

The membership of the Montreal Electrical Society is now over 250, the increase being due to a contest between two sides—the Volts, who put in 112 applications, and the Amperes, who made 92 applications. It has been decided to hold a dinner at the end of March, the entertainment at which will be supplied by the Amperes, the losing side in the contest.

Moose Jaw, Sask.

One of the promoters of the Regina to Moose Jaw interurban railway is reported to have stated that the company's intention is to have the railway in operation by the end of the present year. It is said that the company will use gas electric cars.

Nanaimo, B.C.

Recent advices from Nanaimo state that the Nanaimo Electric Light & Power Company intend to extend the electric lighting system out to Five Acres, a suburb of that city. An order for the necessary equipment has already been placed and it is expected that the work will be commenced in April and completed before next winter.

Ottawa, Ont.

The Niagara, St. Catharines & Toronto Railway Company have been granted a two-year extension of time for the construction of their lines from Port Colborne to Fort Erie to Niagara Falls, and also for the line to Toronto.

Oxbow, Sask.

Electric lighting plant to cost $12,000, is contemplated.

Porcupine, Ont.

The second unit at the Wawaitan Falls, Que., has been brought into use, bringing the capacity of the plant up to about 4,500 horse power. This will insure to the Dome and neighboring mines all the power they require.

Portage la Prairie, Man.

A charter has been granted the Portage la Prairie Radial Railway Company to construct and operate an electric railway system. It is provided that the railway must be commenced within two years and completed within four years.

Regina, Sask.

A by-law was submitted on February 24th to expend $454,086 on extensions to the municipal electric light system.

A by-law was submitted on February 25th to provide for the expenditure of $125,000 in connection with the Regina General Hospital. This is understood to include the installation of a private power plant.

River Glade, N.B.

Tenders were called up to February [illegible] by F. N. Brodie, St. John, N.B., for the [illegible] of a concrete power house in connection with the [illegible]. The capacity of the equipment to be [illegible] approximately 300 horse power.

St. John, N.B.

The International [illegible] had an important hearing in St. John [illegible] recently, in which the matter of the [illegible] for the generation of

electric power by the St. John Hydro-electric Company was taken up. Prominent men in the lumbering industry and representatives of the fishing interests gave evidence before the commissioners. The representatives of the fishing interests were unanimous in opposing the scheme, but the opinions of the lumbermen varied greatly, some expressing the belief that a proper regulation of the river would assist a passage of logs while others opposed the scheme, believing it would delay the handling of their material.

Sarnia, Ont.

It is understood the prices quoted by the Commission for power in Sarnia are as follows: 3,000 h.p. at 13,000 volts, $41 per h.p. year. If up to 5,000 h.p. are taken, this price would be reduced to $31 per h.p. year.

Saskatoon, Sask.

A power rate of 1½c per kw.h. for a 24-hour load has been quoted the Western Canada Flour Mills Company on a 500 horse power basis.

Stratford, Ont.

Equipment is required for extensions to the electric lighting system.

Swift Current, Sask.

Additions to power house to develop 200 horse power are reported to be planned. By-law will be submitted about March 15.

Toronto, Ont.

The Court of Appeal has handed down a decision in the city's appeal from the order of the Ontario Railway and Municipal Board approving the Toronto and York Radial Railway Company's plans for the deviation of their line at Farnham avenue on Yonge street north. The decision of the Court of Appeal is that the company have no right to cross the streets without the consent of the city. The company have already spent a large sum of money in purchasing the right-of-way, excavating and laying part of the track.

As the result of a conference between the Hydro-electric Power Commission of Ontario and a large number of electrical contractors, jobbers and manufacturers, a committee of the latter will confer with the engineers of the commission on the new code of wiring rules to be adopted in Ontario. At the present time the original draft of rules is being revised and a few advance copies will be distributed among those interested, after which any points at issue will be discussed. It is understood that Mr. Beck assured the deputation that the new rules would not conflict with the National Code already in force in Ontario.

Vancouver, B. C.

The Cariboo Power Company, Limited, was recently incorporated with a capital of $250,000, with head offices at Vancouver, B.C. The usual licenses were applied for.

The plans of the recently organized Vancouver Island Hydro-electric & Tramway Company are said to include the construction of a tramway from Nanaimo to Nanoose and Departure Bay on Vancouver Island. It is understood that these two branches of 16 miles and 3 miles respectively, are to be part of a scheme to construct 200 miles of road in the Nanaimo district.

Victoria, B.C.

The Portland Cement Construction Company's plant at Bamberton is nearing completion. The B. C. E. R. Co. will supply the necessary energy up to 2500 h.p.

Most of the offices in the Victoria City Hall are now heated by electricity. This class of business as well as electric cooking, has a very strong hold in Victoria.

Contracts for 1913 supplies have been awarded as follows: Solid carbons and cored carbons, the Northern Electric & Mfg. Company, 313 Water street, Vancouver, at $19.25 per M. and $19.70 per M. 1440 glass ball globes at $10.50 per doz. and 100 glass ball globes of different sizes at $18 per doz., the Can. Gen. Elec. Co., 1065 Pender St. W., Vancouver.

Welland, Ont.

Petitions are being circulated in Stamford township to secure the erection of a hydro-electric distribution system. This is an unusually thickly settled township, also containing a number of factories.

Winnipeg, Man.

Erection of power sub-station No. 3 to take the form of an annex to the terminal station on Rachel street is contemplated.

Escher Wyss & Company, Montreal, have been awarded the contract for the manufacture and installation of three water wheels and governors of 6,800 h.p. capacity each, for the extension of the city of Winnipeg's power station at Point du Bois.

Moonlight Schedule for March, 1913

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
Mar.1	6 20	Mar.2	5 20	11 00
2	6 20	3	5 50	11 30
3	6 20	4	5 50	11 30
4	6 20	5	5 50	11 30
5	6 20	6	5 50	11 30
6	6 30	7	5 50	11 20
7	6 30	8	5 40	11 10
8	6 30	9	5 40	11 10
9	6 30	10	5 40	11 10
10	6 30	11	5 40	11 10
11	6 30	12	5 40	11 10
12	6 30	13	5 30	11 00
13	10 40	14	5 30	6 50
14	11 50	15	5 30	5 40
16	0 50	16	5 30	4 40
17	1 50	17	5 30	3 40
18	2 30	18	5 30	3 00
19	3 10	19	5 20	2 10
20	No Light	20	No Light	
21	No Light	21	No Light	
22	No Light	22	No Light	
23	6 40	23	9 30	2 50
24	6 40	24	10 50	4 10
25	6 50	26	0 10	5 20
26	6 50	27	1 50	7 00
27	6 50	28	2 20	7 30
28	6 50	29	3 20	8 30
29	6 50	30	4 10	9 20
30	6 50	31	4 50	10 00
31	6 50	Apr.1	5 00	10 10
			Total..........	226 00

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Generation, Transmission and Application of Electricity

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An Eighty Per Cent. Load Factor

Load-factor may be defined as the ratio of the total number of kilowatt hours sold, to the total number of kilowatt hours a plant is capable of delivering over a stated period, generally 24 hours. It varies from a minimum of 15 per cent. or 20 per cent. to a maximum of 80 per cent. or higher. It is probably safe to say that in the vast majority of central stations it runs below 50 per cent., perhaps below 40 per cent. This means at least that the revenue from most electric plants is only 40 per cent. what it, theoretically, should be—a point not appreciated by the consumer and often, it is said, not recognized by the central station operator himself. The matter, however, is one of the biggest questions confronting the central station man to-day and with increasing competition and lower rate tendencies threatens to reduce revenue to the vanishing point.

That much can be done in improving the load factor has been demonstrated during the last three or four years by many of our well-managed systems and the fact that in central Ontario there is one group of plants actually operating up to an average of 80 per cent. capacity during the 24 hour day shows what a diversified load can do in the way of solution of this problem. In this particular plant they have, of course, a load which is unusually near the ideal—a pulp mill and cement mills which operate continuously—but there are to-day so many small electric articles which are at the same time practical, luxurious and commercially satisfactory that no central station seems justified in dragging along on a 15 or 20 per cent. load factor.

In this connection possibly the most promising load of the future, for the average central station, is storage batteries. These possess the advantage that they can be charged at any time to suit the plant. There is no doubt that batteries are not yet as generally used as their usefulness, life and efficiency would justify. Where the peak load is of short duration they may be used to advantage in the main power house or they may carry a light load at any hour when the load does not justify the operation of the plant. Two of the smaller sized plants in western Canada are reported to be getting splendid results from batteries used in this way.

It is worthy of note also that improvement in load-factor not only increases the revenue, but makes it possible to reduce the general rate to the consumer—a course always justified, not only in that a still larger load is induced, but also in that the attitude of the consumer becomes more friendly with every indication that his interests are being considered.

Value According to Comparative Worth

What appears to be a precedent was recently established by the judgment of Chief Justice Davidson regarding expropriation proceedings taken by the Cedars Rapids Manufacturing & Power Company, regarding two islands belonging to the De Beaujeu estate, Montreal. The Cedars company required two islands, the Isle aux Vaches and the Pointe du Moulin. The matter was originally arbitrated according to a statute of the province of Quebec which gives the owner of a water power right to expropriate property in the neighborhood required for the development of his power. The arbitrators' award for the two islands totalled $4,500—their value when considered only as farm lands. This award was opposed by the De Beaujeu estate on the ground that the value should have been fixed from an industrial point of view. This contention has been upheld by the recent decision which places the value of the two islands at $142,000. By this judgment it would appear that a precedent has been established whereby expropriation values will be regulated by the comparative worth of the property expropriated with reference to its value as a part of the completed plans of development.

Hydro Developments

The citizens of the town of Collingwood will long remember the night of the 24th of February, 1913, when the introduction of hydro power marked a new era in the prosperity of this town. Hon. Adam Beck was present and the town hall, where a banquet was given in his honor, was over crowded to accommodate the guests, which included Hon James S. Duff and Major Currie, M.P.

The power is obtained from the Big Chute on the Severn River, where the falls have been developed by the Simcoe Railway & Power Company, who sell under contract to the Hydro-electric Power Commission of Ontario. At this point there is a thoroughly modern generating plant of about 7,000 h.p. capacity. The turbines were built by the Wm. Hamilton Company, of Peterborough, and the generators by the Canadian Westinghouse Company. The plant was designed and the equipment installed under the supervision of C. H. & P. H. Mitchell, consulting engineers, Toronto.

Collingwood is one of the group being served by high tension transmission lines now being installed by the Commission to cover the section including Orillia, Barrie, Penetang, Midland, Collingwood and smaller towns included in this area. Power is transmitted along this line at 25,000 volts. At Collingwood it is stepped down to 2200 volts, at which pressure it is distributed throughout the town for light and power.

The agreement between the Hydro-electric Power Commission and the Simcoe Railway & Power Company is as follows:—200 h.p. $21 per h.p. year at 2200 volts, or $20 per h.p. year at 22,000 volt. 500 h.p. $20 and $19. 1,000 h.p.

$19 and $18. 1,500 h.p. $17.50 and $16.50. The town of Collingwood contracted for 700 h.p. at $33.97 per h.p. year. This amount is already over-sold and it is anticipated that next year twice the amount will be required. The system is under the control of a commission of three; Messrs. J. A. Cas ake, chairman, Mayor R. Gilpin and H. A. Currie. Mr. E. J. Stapleton, who has been in charge of the construction work throughout, is now superintendent of the system.

As illustrating the advantages already accruing from the installation of this system we quote the following from the Collingwood Enterprise:

"The Enterprise Publishing Company is one of the first plants in town to utilize the new power. All our presses are now harnessed up to hydro-electric, and it is astonishing what a difference it makes. The smooth running of the presses is particularly noticeable, whether run by day or night, and regardless of the number of machines running at once. The running of the Monoline machine alone would warrant the introduction of the new power."

Electricity on the Farm

In order to satisfy the growing demand for electric light and power in rural districts the Electric Power Company are now actively engaged in building a number of rural distribution lines. One of these, viz., a 2200 volt, single phase line, about 10 miles in length, from Napanee through Newburg to Camden East, has now been in operation for some time. It is fed from the Electric Power Company's sub-station at Napanee. Distributed over the 10 miles of line are now about sixty customers.

Another of these lines, extending about 12 miles in a southeasterly direction from Campbellford, will be in operation before the end of the present month, with between 20 and 25 customers, most of whom have contracted for from 1 to 3 h.p. There is also one customer on this line who has contracted for 25 h.p. The line will be fed from the Stephens Dam power house at Campbellford at 6600 volts, single phase. Pole type transformers are used, having a ratio of from 6600 to 120/240 volts. As a rule a separate transformer is installed for each customer.

Other lines in prospect, which will be constructed in the near future, are as follows:

From Lindsay to Mariposa and Oakwood. 12 miles
From Whitby to Pickering ... ... 12 miles
From Belleville to Foxboro ... ... 5 miles

The farmers along the routes of these lines are having their houses and barns wired for lighting and are installing motors for pumping water, sawing wood, chopping feed and various other purposes.

Copper in 1912

A preliminary report on the mineral production of Canada during the calendar year 1912 has just been published by the Department of Mines, in which some interesting information is given with reference to the production and price of copper during the year. The average price is given at 16.341 cents, as compared with 12.376 cents in 1911, 12.738 cents in 1910, 12.982 cents in 1909, 13.208 cents in 1908 and 20.004 cents in 1907. It would appear that during the past year copper has made its first recovery from the 1907 slump caused to a very considerable extent by the advent of aluminium into the field of electrical conductors. With reference to copper the report contains the following:

"There is practically no recovery of refined copper in Canada and the production is represented by the copper contents of smelter products, matte, blister-copper, etc., together with the amount of copper contained in ores exported, estimated as recoverable. The total production on this basis in 1912 was 77,775,600 pounds, valued at $12,709,311 as compared with 55,648,011 pounds valued at $6,886,998 in 1911, an increase in quantity of 22,127,589 pounds and in value of $5,822,313. Quebec province is credited with a production of 3,225,523 pounds as against 2,436,190 pounds in 1911, the increase being due to the increased production from the pyritic ores of the Eastern Townships. Ontario's production in 1912 was 22,250,601 pounds, as compared with 17,932,263 pounds in 1911, being mainly derived from the nickel-copper ores of the Sudbury district. Apart from the copper shipments from Dane, the most interesting occurrence was the payment made for copper in shipments from the Cobalt camp. British Columbia had a record output of 50,526,816 pounds, having had a year of uninterrupted smelter operation free from strikes and other disturbances. From the Yukon the Pueblo mine was a heavy shipper. The New York price of electrolytic copper varied during the year between 13.75 cents per pounds in February, to 17.60 in August, the average for the year being 16.341 cents as against an average monthly price of 12.376 cents in 1911. The exports of copper in 1912 were: copper, fine in ore, etc., 76,542,643 pounds, valued at $8,800,276 and copper black or coarse and in pigs, 1,945,921 pounds, valued at $236,212. The total imports of copper in 1912 were valued at $7,052,534."

Mr. Wickes' Statement Explained

In our issue of February 1, reference was made to a report by Mr. Wickes on the Underwriters' Laboratories of Chicago, and special mention was made of a remark in the report concerning the allegation that it was necessary to gain the inspectors' good will by means of a tip in order to facilitate the passing of material submitted. Our editorial remarks were written under the impression that these inspectors were a part of the Underwriters' Laboratories organization, and we had this connection in mind when we suggested that steps should be taken to show up the workings of the Underwriters' Laboratories.

The following extract from a letter from Mr. W. H. Merrill, manager of the Underwriters' Laboratories, makes it plain, however, that our inference was in error, and we are very pleased to be able to revise our interpretation of the report, as will, doubtless, many of our readers. Mr. Merrill points out that there is no connection whatever between the inspectors (referred to in the report) and the Underwriters' Laboratories, and writes in part.—"Mr. Wickes says in effect that representations are made that certain inspectors in the field (who may be operating under government or city or underwriters or other authority) object to passing electrical fittings not bearing our approval, and in certain cases it is intimated that these inspectors might be open to bribery or their opinions influenced by tips or "douceur." Please note that these inspectors to whom Mr. Wickes refers are not and cannot be connected in any way with this institution, as we have no one in our employ engaged in inspection work in building equipments, our efforts being exclusively confined to experimental work in our testing stations and examinations of approved wares at manufacturers' plants where such wares are turned out. Through many years of earnest and constant effort we have built up a good-will for this institution which is based more than on any other one thing on the integrity of all members of our staff."

If you work for a man, in Heaven's name work for him. If he pays you wages that supply your bread and butter, work for him; speak well of him; stand by him and stand by the institution he represents. If put to a pinch, an ounce of loyalty is worth a pound of cleverness.

Montreal Underground

The Quebec Public Utilities Commission have passed the plans of the Montreal Electrical Commission for underground conduits on St. Catherine street, from Guy street to Papineau avenue. This is the first section of the work, which will ultimately cover the city. Tenders for the construction of the conduits will be called in the near future. The system consists of groups on main runs of 3½ in. square tile, standard lengths, for all main ducts, 15 on the north side from Guy street to Papineau avenue, and 20 on the south side in one section and 16 in other parts. Provision is made for the cables of the tramways company, lighting, and power companies, etc., which, together with other parts of the conduits, will be rented to the companies at a sum which will pay for maintenance, cost, etc., the whole cost to be paid off in forty years.

The service ducts are 3½ in. round fibre; these run from the service manholes to the various stores or houses in each block, with a maximum of eight services from each service manhole. There are also on each side of the street groups of 3½ in. fibre conduits for the various signals, such as fire alarms and street lighting circuits. Access to the main ducts is given through manholes on each side of the street at the various street intersections, there being four of these manholes at the street intersections where the tramways cross or join, and at all other street intersections there are only two main manholes, where are also situated transformer manholes, where the current is transformed. The main and signal conduits cross St. Catherine street at the street intersections between the main manholes. The plans have been drawn under the direction of the Montreal Electrical Commission, with Mr. A. S. Clarson as acting chief engineer.

Public Service Corporation

The Saraguay Electric and Water Company have changed their name, in accordance with the recent act of the Legislature, to Montreal Public Service Corporation. The company have acquired the Paul Electric Light & Power Company, the Dominion Light & Power Company, and the distribution lines of the Canadian Light & Power Company, so that in future the distribution on the Island of Montreal of light and power by the Robert interests will be carried out under the name of the Montreal Public Service Corporation. Mr. E. A. Robert is the president of the company; Mr. H. R. Mallison, secretary-treasurer; and Mr. K. B. Thornton, chief engineer and operating manager. The interests of the Montreal Tramways Company, the Montreal Public Service Corporation, and the Canadian Light and Power Company are in the hands of the holding company known as the Montreal Tramways and Power Company. The current for the Montreal Public Service Corporation is supplied by the Canadian Light and Power Company.

Calgary Report

Superintendent of Light & Power R. A. Brown has prepared a report covering the operations of his department during 1912, which shows a surplus of over $36,000 for the year. As indicating the advantages of municipal ownership in Calgary, it is pointed out that in 1905, when the city decided to install its own plant, power was selling at 18c per kw.h., which has been gradually reduced to 7½c, the present rate. The new street lighting now covers 201 miles of streets, with 1100 lights, of which 600 are magnetite arcs, 260 a.c. enclosed arcs and 240 50-watt, 6.6 amp. tungstens. Mr. Brown states that though a by-law has been passed providing for the installation of five-light ornamental standards on a number of streets in Edmonton, the magnetite arcs which have been given a good test since the vote was taken on the by-law, have proven so satisfactory that it appears to be the concensus of opinion that the arc light is preferable to the tungsten standards. The estimates for the current year provide for an expenditure of $460,000.

Undergound Conduit Statistics

Steps are being taken by the National Electric Light Association to compile a record of the towns and cities in the United States and Canada which have underground circuits and systems together with the nature and extent of the same. This information is to be regarded as confidential and will be kept on file for reference in cases where such work is proposed. The collection of this information has very generously been undertaken by Mr. G. M. Gest, the well-known conduit specialist. To this end cards are being sent to the general managers of all central station plants in Canada and the United States, asking whether they have any conduit installed, whether the telephone, telegraph, traction companies or the municipality have ever done such work, and, if so, what is the amount in each case. There is no doubt that a compilation of this form of information would be exceedingly valuable and all central station managers are urged to answer the questions promptly and fully.

Electricity for Farm and Home

At Greenwood, Ont., there is a small private hydro-electric plant which is demonstrating the value of electric power on the farm and in the country home. The plant is owned by Mr. F. L. Green, miller and farmer, and its construction and operation are briefly described by the owner as follows:

"We already operated a flour mill by water power, and so did not need to build a dam specially for the electric power. We, however, use a separate 10 h.p. water wheel to drive a 5 h.p. dynamo. The water wheel is fed from the main penstock which feeds the large mill wheel. It is a horizontal Leffel type with vulcan gate enclosed in an iron case and operates under a head of about 42 feet running at 800 revolutions per minute. The dynamo, which is a direct current 110 volt machine, is belted to the turbine. No governor is used on the water wheel and any change of load is regulated by taking off or putting on more water on the wheel. As the mill is running practically all the time, and lights from this dynamo are used there, the mill hands can notice the change in voltage representing a change in speed and they regulate the wheel accordingly. If the wheel was isolated as it would be if it were a separate installation used for no other purpose than lighting, it would, of course, be necessary to have a water wheel governor to regulate the speed or some other method of voltage regulation.

We use the dynamo for lighting the mill, office, barns, stables, dairy building and residence, which is done in a most satisfactory manner, the buildings being all well lighted and my house exceptionally so. We have over forty 16 candle power lamps in the house and some 25 candle power tungstens. We generally have about half of these on and run the dynamo a little fast to give 4 to 5 volts above the marked voltage of the lamps so as to get a better and brighter light. From the steady and even speed of the water wheel we get a very steady light. I have noticed that dynamos when driven by a gasoline engine sometimes give an unsteady light which is hard on the eyes, as the light goes up and down following the necessary changes of speed in the engine.

Besides lighting my buildings I have a motor in my dairy building to drive my separator, pasteurizer, churn and milking machine, and over my dairy building we have a well-equipped work shop so that we do most of the repair work

required on the farm as well as manufacture a lot of material. In this shop we have a small circular saw and an emery wheel both motor driven.

I might also say that we are connecting our vacuum by underground piping to the house, which we have had piped for a vacuum cleaner. In this way our vacuum pump, which we now used in connection with our milking machine, will also give us the necessary vacuum in the house.

We have had this electrical installation in operation for several years, and it has given very little trouble and very little expense. My present intention is to put in a dynamo large enough to run a motor to drive a threshing machine, fill the silo, and do other heavy work around the farm. Of course, the installation of this plant cost very much less than it would if I had had to build a dam and put in a water wheel just for the electricity. However, where a small water power is available in a convenient point there is no reason why a few farmers could not club together and put in a plant to supply them with light and power at a cost which would be very moderate compared to the advantages they would derive from it. There is no question in my mind but that electricity cannot be equalled for availability and ease of control and operation where a water power is available.

I might add to the above that I have a laundry room built next to my dairy and am arranging to run the washing machine, wringer, etc., by electricity. Electricity is already used for ironing, also for heating water and making tea and coffee for the table."

Air Purified by Ozonators

By Mr. S. W. Canniff

The atmosphere is a mixture of gases made up chiefly of oxygen and nitrogen which form 97.7 per cent by weight. Nitrogen, atomic weight 14, constitutes 77 per cent. by weight of the atmosphere. It is an inert gas, whose function, with respect to human life, is to modify the action of other gases. Oxygen, atomic weight 16, is the most important constituent of the air. By weight it is about 20 per cent. of the atmosphere, and by far the most abundant element in nature, probably forming in a state of combination about one-half the whole weight of the globe. Burning, generally speaking, is oxidization; i.e., a combining of oxygen with other substances to form compounds essentially different from their constituents.

Oxygen combines more or less readily with every element except flourine and five very rare gases; krypton, neon, argon, xenon, and helium which have never been known to combine with any elements. Chiefly by this widely applicable means, namely, the ready combination of oxygen, nature destroys obnoxious and dangerous matter. A convincing illustration of this is found in the fact that the warmth of the body is produced by a continuous burning up of objectionable tissue by the oxygen of the air drawn into the lungs. In the economy of nature, this is at once a process of purification and production, whereby food matter in being consumed evolves heat energy.

Ozone is a form of oxygen in its most active state. In chemical terms it is represented by the formula O_3, as compared with normal oxygen, which is O_2. This means that the normal oxygen unit or molecule O_2, is made up of two atoms which are in fairly stable relation, while the ozone molecule O_3 is made up of three atoms of oxygen. This, however, is a combination which is very unstable and hence extremely active. The extra atom is, so to speak, held by very slight restraint, and is eager to break loose from its kind and to combine where there is greater chemical attraction.

Ozone is produced in a variety of ways in nature, the most spectacular being by the electric discharges from cloud to cloud to earth in thunderstorms. It is supposed, then, that the molecules of O_2 become ionized; i.e., disrupted, and the liberated atoms collide at great velocity to form new combinations or molecules of O_3, ozone, which is highly active as compared with ordinary oxygen, O_2. Ozone is comparatively absent from cities and malarial regions, but fairly abundant in mountains and especially evident in coniferous forests. Therefore the amount of ozone appears to vary directly as the degree of atmospheric purity in the locality. Vice versa the amount of ozone present should regulate the purity of the atmosphere. This is because ozone is an intense oxidizer; it attacks and destroys many organic bodies not actively attacked by normal oxygen, and, in general, all noxious gases and substances are organic.

From the above it is patent that the presence of ozone is an index of healthful surroundings, or the converse, the absence of ozone is a proof that all of nature's purifier having been utilized the air is contaminated and will become increasingly so until a fresh supply of ozone is available.

Ozone is now being produced in considerable quantities by an electric device called the Ozonator. The production

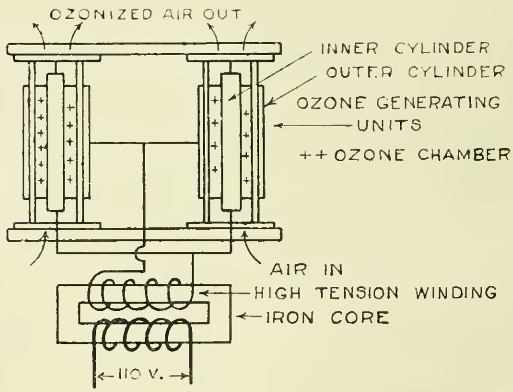


Fig. 1.—Wiring plan of Ozonator

of ozone artificially and, at least, commercially is based on precisely the same principles as exist in its generation by the lightning discharge. A miniature artificial lightning discharge of great area is provided by means of electrified plates surrounding a field under electric stress, through which air is passed. It has become generally known, therefore, that ozone can be quickly and conveniently produced by the discharge of air between electrified surfaces, and apparatus built on these principles is in very common use.

The Ozonators contain a step-up transformer, and ozonizer, and controlling switches. The accompanying figures will illustrate the principles involved. The step-up transformer is situated in the lower part of the case and changes the supply voltage in the alternating current machine to a value sufficiently high to produce ozone when applied to the ozone-generating units. The correct voltage has been very definitely determined by experiment, and established at a value that will not give harmful gases within a limit that can be detected by the recognized methods of measurement. Above the transformer is the ozonizer proper, consisting of a bank of ozone generating units. Each unit consists of a cylindrical glass tube, on the outside of which is a metallic coating, and inside of which is a metal electrode. The latter is built up of shallow perforated metal cups mounted on a spindle concentric with the tube. The cups are of such a diameter as to allow a small but definite air-gap to pass between them and the surrounding glass tube. When one high-

voltage lead from the transformer is connected to the outer coatings of the glass tubes and the other to the inner electrodes a violet electrical discharge takes place through the air enclosed in this space. This discharge through the air in the small air-gap changes some of the oxygen of the air into ozone.

Ozonators are made in a number of sizes. The smaller size, shown herewith, has two generating tubes with an output of 150 milligrams of ozone per hour, and a power consumption of approximately 11.5 watts. This device is strongly built, and has a painted metal cover, and is suitable for the purpose of sanitation in such places as lavatories, basements, small kitchens, etc. Connection currents set up by the heat of the transformer maintain a continuous movement of the air, which enters from beneath in the impure state and passes out at the top charged with ozone.

The medium size has four generating tubes, with an output of 400 milligrams of ozone per hour, and a power consumption of approximately 15 watts. This is a beautifully constructed device, and will harmonize with the finest furniture in any residence or hotel. The case is of solid mahogany, provided with handles consistent with the finish of the case, and is used for purifying the air in homes, theatres, hotels, offices, etc.

A large size ozonator, in addition to the step-up transformer, ozonizer, and controlling switches, is provided with a motor driven fan. This fan insures a flow of air through

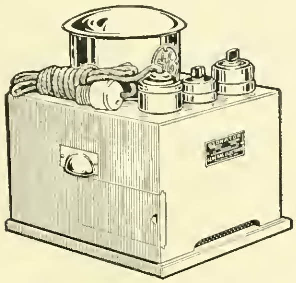


Fig. 2.—Showing small type Ozonator

the generating tubes (nine in number) and a thorough expulsion of the ozonized air into the room, thereby increasing the effectiveness of the device. The output of this machine is 678 milligrams of ozone per hour. It will deliver 113 cubic meters (4,000 cubic feet) of ozonized air per hour, which, under ordinary conditions, is sufficient for a room of 50,000 cubic feet capacity, such as large offices, banks, theatres, churches, public halls, etc. The power consumption of this ozonator is approximately 78 watts.

A fourth, or extra large ozonator, is similar in construction to the one previously described (large size) but has 25 generating tubes with an output of 1400 milligrams of ozone per hour. This type is for use in extensive buildings, large theatres, factories, etc., where large quantities of ozone are required. The power consumption of this ozonator is approximately 105 watts.

Ozone is becoming a very important adjunct to all ventilating systems, as it is used extensively in conjunction with blower heating and ventilating systems, the ozone generating tubes being placed in the air intake of the fan, thus purifying the air before it is heated and distributed. This applies to such places as stations, public buildings, department stores, etc. The most extensive system designed for the specific purpose of purifying the air by the use of ozone is the subways of London, where 8,000,000 cubic feet of air per day are ozonized. Previous to this installation the subways were subject to much adverse criticism, but they are now favorably commented on.

Operating Costs of Gas Plant

Many of the smaller towns in Canada are installing gas engine plants of a capacity of approximately 400 h.p. or under, and are apparently producing power at a rate which compares favorably with the figures shown in many large central stations. Actual operating figures are, of course, always very difficult to obtain, and the following data from the records of a municipal electric lighting plant at Minster, Ohio., given by Mr. Utz, in a recent issue of "Power," should be typical of what might be expected from these plants under average conditions.

The plant consists of one 12 x 12-in. and one 11 x 12-in., three-cylinder vertical four-stroke-cycle gas engines direct connected respectively to 62.5 and 50-kw., 250-volt direct-current generators.

Table 1. Typical Daily Load

Time	Cu. ft. of gas consumed per hr.	Output in kw. hrs.
1 a.m.	415	26
2	410	24
3	390	24
4	385	23
5	375	23
6	325	13
7	400	25
8	550	40
9	475	36
10	475	35
11	475	35
12 noon	400	26
1 p.m.	375	25
2	375	45
3	475	36
4	500	40
5	475	38
6	425	26
7	475	31
8	585	43
9	590	43
10	450	27
11	400	23
12	325	19
Total	10,725	723

Average gas consumed per kilowatt-hour=14.8 cu. ft.
Oil consumed = 4 gal.

Both engines have make-and-break ignition, current for engine No. 1 being supplied by a magneto bolted to the engine frame and driven by a friction pulley from the flywheel; engine No. 2 is supplied by a ¼-kw. generator belted to the engine shaft. Both are equipped with batteries for starting or for use in case of breakdown of the magneto or generator.

Compressed air at 225 lb. pressure is used for starting, this being furnished by a 3 x 4-in. duplex compressor, belt-driven by a 2-h.p. gas engine Natural gas of about 900 B.t.u. per cu. ft. is used for fuel. The engines are lubricated by the splash system and use four gallons of oil per 24 hours, the oil costing 19c per gallon.

The first cost of the engines, generators, air compressor, tanks, switchboard, etc., was $9,000. Engine No. 1 has been in service three years, running about 16 hours per day, and engine No. 2 has been in service two years, running about 18 hours per day. The repairs on these engines since their in-

stallation have been practically nothing, and the service is good.

Owing to the fluctuations of the day load, and the ease of starting an engine, one engine is started and stopped quite frequently. An engine can be started, brought up to speed and cut in at the switchboard in parallel with the other in a little over a minute.

Table No. 1 shows how the load varies during different periods for a typical daily run, and Table 2 gives the gas consumption and electrical output for the month of April, 1912. Table 3 gives figures on the cost of power for one month, is fairly accurate and also a good average for the year.

Table 2. Gas Consumption and Electrical Output for One Month

Date	Cu ft. of gas consumed	Output in kw.hrs.	Fuel cost per kw.h. in cts.
April:			
1	9,500	560	0.0050
2	9,850	599	0.0049
3	10,200	635	0.0048
4	9,825	587	0.0050
5	9,725	566	0.0051
6	10,950	684	0.0048
7	6,350	369	0.0051
8	10,000	642	0.0046
9	9,850	625	0.0047
10	10,050	638	0.0047
11	9,875	653	0.0045
12	10,000	660	0.0045
13	10,650	682	0.0046
14	5,875	304	0.0058
15	10,125	665	0.0045
16	9,750	621	0.0047
17	10,950	724	0.0045
18	10,725	723	0.0044
19	10,325	677	0.0045
20	10,400	658	0.0047
21	5,550	287	0.0058
22	9,525	561	0.0050
23	9,375	578	0.0048
24	9,175	552	0.0049
25	8,975	536	0.0050
26	9,375	575	0.0048
27	9,775	615	0.0047
28	5,375	276	0.0058
29	10,900	705	0.0046
30	10,250	651	0.0047
Total	283,250	17,608	Av. 0.0482

Table 3. Total Costs for Month

Fuel:

283,250 cu. ft. of gas at 0.30c per 1000 cu. ft..... $84.97

Labor:

2 engineers at $55 each 110.00

Oil:

120 gal. at 0.19c per gal. 22.80

Interest, depreciation, etc., 15 per cent. per annum on $9,000 ... ... 112.50

$330.27

$$\text{Cost per kw.hr.} = \frac{330.27}{17,608} = 1.87\text{c.}$$

Toronto Section A. I. E. E.

The next meeting of the Toronto Section A. I. E. E. will be held in the Engineers' Club on Friday March 28. Mr. F. W. Peek, Jr., an assistant engineer to Dr. C. P. Steinmetz. will speak on "High Voltage Engineering."

Electric Trucks as a Power Load

Relative Importance of the Electric Truck as Compared With Other Classes of Central Station Business*

By H. W. Hillman

In the early 80's it was quite out of the question to even consider a subject of this kind. Certainly it was too early to think of a street railway load. It was a period long before miscellaneous heating devices and household utensils had been developed, and the splendid, ever-increasing industrial motor business was unknown to the central station manager. To-day, however, there is such a variety of electric devices and so many branches of business that need attention that it surely becomes interesting to analyze the relative importance of the more prominent classes, and to show why one class differs from another class in character and in importance.

What is it that makes one class of business more important than another class to the central station?

It is difficult to remember a time when central stations did not pursue the familiar policy of favoring "long hour" business. No one would think of questioning the policy, and so we are led to emphasize that electric trucks offer the desirable "long hour" business. As we advance with our argument, it will be found that this "long hour" feature stamps the electric truck branch as of far greater importance than many central stations have begun to realize. It was the "long hour" business which first attracted central stations to the industrial motor load. It was "long hour" business which led to such effective organization among the central stations in connection with power bureaus and industrial motor salesmen. Now it is a rare occurrence to visit a light and power company that has not vigorously promoted the motor business.

The National Electric Light Association has recently sent out some very interesting data relating to 114 motor installations. It was issued in book form by the commercial section and reflects great credit upon the work and activity of that body. Among the motor departments of all the central stations, it will be found of daily value. It is interesting while perusing this compilation carefully to note that 29 installations out of 44 which show load factor indicate that it is not over 10 per cent. Thus we see that it is not over three hours per day that the 29 installations are in service.

Long hour, uniform load

It is common knowledge that electric trucks are on charge six to eight hours each and every night, and surely we are warranted in claiming a marked advantage for the electric truck on account of such long hour business.

This load factor of 30 to 35 per cent. is uniform. It does not vary with the size of the truck nor with the number of batteries on charge, except, as has been forcibly brought out, that in a large size garage one-half of the installation can be charged the fore part of the night and the balance the latter part. By this practice the central station secures a 12 to 16-hour load of uniform character.

Next your attention is drawn to the "low demand" of the electric truck. For the same amount of plant equipment necessary to operate, the electric truck has eight and one-half times the earning capacity of the electric flat-iron. While it takes 86 irons to equal the annual income from one two-ton truck, the irons demand 51.6 kw. to operate, against 6 kw. for the truck.

For fear that some sales manager may question my comparison of the small electric iron with the large important truck, I have made comparisons with 12 classes of central station business other than the irons; that is, I have

*Read before the Electric Vehicle Association of America.

marched boldly into his camp with practically every branch of business associated with the electrical industry. Annual income per kw. of plant equipment necessary to operate 12 different classes of installations:

Installations.	Annual Income per kw.
1. One two-ton truck	$ 86.00
2. Residence, small	15.22
3. Retail store, small	31.75
4. Church	32.57
5. Industrial one-motor	43.16
6. Industrial two-motor	41.18
7. Industrial three-motor	19.61
8. Industrial eight-motor	50.96
9. Industrial twenty-motor	35.11
10. Residence, large	63.04
11. Drug store	118.40
12. Saloon	191.51

Above comparison is made from data recently secured from thirty central stations, showing average rate per kw.hr., monthly consumption in kw.hrs., maximum demand per kw. and connected load. Size of cities as follows:

1 in excess of 1,000,000 population.
4 between 200,000 and 500,000 population.
7 between 100,000 and 200,000 population.
8 between 50,000 and 100,000 population.
9 between 25,000 and 50,000 population.
1 less than 25,000 population.

The above table of comparison brings out clearly that the electric truck business stands at the head of the list as an income getter. It stands at the head of the list in respect to the small demand upon the plant equipment, and again it stands at the head of the list for long hour business.

A good income getter

As a matter of fact it is unique in a great many ways. While the drug store and the saloon business apparently make the better showing, neither one nor the other possesses the broad extensive field which the electric truck business is bound to enjoy.

Glance for a moment at the five motor installations in the table. Who would have thought that electric trucks would make such an excellent showing when compared with the prize branch of the central station business; that branch, the rapid and extensive development of which has astonished the entire industrial world; a business now rich with power bureaus, power engineers, power solicitors and power accomplishments second to none in connection with the history of the electrical industry. Perhaps some one is wondering if the data is authentic and accurate. Let's read the note at the bottom of the table. Then we may surely feel that it is representative and practical, answering the purpose as set forth.

A house wiring campaign is a very common class of business for the central station manager to exploit. In a western city some 1,350 houses were wired during a period of 18 months. Only 67 extensions had to be made "off the lines" and only six solicitors were employed to promote this business. Many a central station has conducted a similar campaign, and has thus not only prepared the way for a large residence lighting business, but likewise arranged so as to easily promote business later, covering miscellaneous heating devices and household utensils.

Like the motor business, all of this work is admirable. But if the central station sales manager realized that only fifty electric trucks would produce the same annual income which is derived from 1,350 houses, would he start out boldly with six solicitors? Would he adopt an aggressive policy if some one should remind him that all the truck business could be taken on without the purchase of any additional plant equipment? Would he put on twice six solicitors if he actually realized the value of long hour business and the enormous field which is loudly calling for promotion and development? Will it encourage the central station sales manager to employ truck salesmen when he realizes that in the Newark territory 181 electric trucks have been placed in operation, with the excellent result that the automobile department showed a profit even during the year 1912?

Returning again to the point of "low demand." This is a feature of vast importance and perhaps can be emphasized most forcibly at this time by reminding you of the high demand of certain other classes of business and the effect upon the development and growth of such business. Let us consider the situation regarding an electric cooking and baking outfit for the residence kitchen. It advanced from the laboratory into the engineering department; from there into production, and was commercialized to a limited extent. But electric cooking and baking by electricity is not being extensively exploited. The demand is too high for the income possible.

The oven alone had a demand of 2.2 kw. With the addition of the meat broiler, the cereal cooker and the variety of necessary cooking appliances the demand would run as high as 5 kw.; to be conservative let us say 4 kw. This is two-thirds of the demand required for a two-ton truck, which has an annual earning capacity of $516. But the cooking and baking outfit has to compete with coal at $7 per ton, and at a special rate of 5 cents per kw. hour. My bills for five consecutive years averaged $5.66 per month in a family of five with one servant. In other words with two-thirds the demand the annual income would be about $68, against $516 for the truck.

Most energetic efforts have been made to lower this demand by utilizing the principle of the fireless cooker for conserving heat, but until this is effectually accomplished electric cooking among residences will not be extensively exploited because of high demand, because it does not possess the advantageous feature of low demand which the electric truck enjoys.

I want to emphasize this point of "low demand" still further by referring to another branch of business in connection with which high demand has held back development and commercial exploitation by the central station.

In building my house in Schenectady I wired completely with heavy feeders for a thorough test of electric house-heating. For months my furnace was not operated at all and entire dependence was placed upon the electric heating system. In six rooms upstairs one kw. each was required. In the large living room downstairs, three 1 kw. heaters were installed. The complete installation required 12 kw., or twice the demand of a two-ton truck. To compete with coal the annual income should not be more than $125 to $150 for heating that size of residence. Thus we see that with only one-fourth the income of the electric truck the demand would be approximately double. It would be a great burden on the central stations to exploit electric house-heating at the present time, for the reason of high demand. Such a class of business requires that the current be distributed into outlying territory. Even if generator capacity could be easily secured, or if it were at present available, extensions would be required all along the line, from the station to the incandescent lamp, including primary and secondary lines, transformers, meters, etc.

No distributing outlay

But this is not true regarding the electric truck business. It not only possesses the advantage of "low demand," but the current does not have to be distributed into the outlying territories. Without change of any of the system the business can be exploited. Neither a change in the distributing system nor a change in the station proper, not even

increased generator capacity, because the batteries are charged at night.

Was there ever a branch of business possessing such splendid advantage? Is it any wonder that sales managers are beginning to organize to handle electric truck business aggressively?

Surely the time will come when house-heating and cooking and baking and innumerable other electrical fields will be thrown open for active exploitation, but to-day the path of least resistance leads to the electric truck class of business, and as related to all other branches which the central station deals with, there is no other of equal importance at the present time. But it needs more attention from the sales manager of the central station. It is a selling proposition.

I have shown that the current is abundantly available. We all know that electric trucks are thoroughly developed and successful as a commercial product. What the business needs is the benefit of the sales manager's experience, his judgment, his approval, his influence with the public, his influence with his own organization. Wherever this policy prevails, there we may look for progress.

Baltimore, for example, adopted this policy, and, better yet, has organized to push the sale of electric trucks. Besides the great advantage gained from the hearty support of the sales manager, there is an automobile department and its manager. He has a truck salesman, giving undivided attention to the subject. On a recent important deal five truck men were available, impressing the customer with the idea that the Baltimore company is intensifying the truck business. This is one of the reasons why upwards of 75 trucks have been placed by that company in a comparatively short time.

We appeal for the same intensity and activity which the sales manager puts into the subject of isolated plants. We appeal for the same character of literature which is found in the power bureau, which is distributed to customers and which reads something like this: "We will gladly send a motor engineer to your factory; we will make a test of your steam plant; we will submit to you a proposition showing the economy by the use of our motor service." That will imply that truck salesmen are available to send out; that they are posted to meet the arguments of competitors, and that they are educated regarding all kinds of batteries. Then will the electric truck business commence to boom. Then 30,000 motor trucks mentioned in one of your recent pamphlets will mount up to 300,000, and instead of 8,000 only being electrics, the ratio will be reversed; 225,000 will be electrics and the balance may be gas.

Campbellford, Trent Canal, a Power Centre

Two Hydro Electric Plants, Pulp Mill and Paper Mill—The Town and Surrounding Country Well Served

In the Electrical News of June, 1910, a description of the preliminary development works of the Seymour Power & Electric Company at Campbellford on the Trent Valley Canal was given in detail. At that time two generators had been installed and power was being transmitted to a number of points in the company's system. Since that date the Seymour Power & Electric Company has been included in the larger scheme of the Electric Power Company, the power development at this point has been completed and this plant has been tied in with all the other generating plants of the Electric Power Company on their 44,000 volt distribution loops.

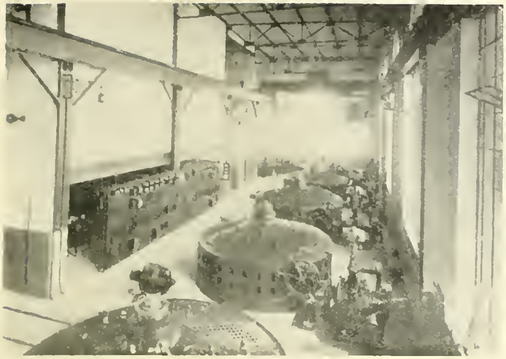
The power house at Campbellford is situated at what is known as Stephens' Dam. This power plant started up in December, 1909, with two 600 kw. generators and 22 miles of 44,000 volt transmission line to Delora. The power developments in this area have been so rapid that the company proceeded to complete the installation as quickly as possible and the power house now contains five 600 kw., 2400 volt, 60 cycle, 3-phase, 150 r.p.m. vertical shaft generators. The general appearance of the completed power house is shown in one of the photographs herewith.

In addition to the above mentioned generator the power house also now contains one 60-kw. vertical shaft, turbine exciter, 125 volts; one 75-kw. induction motor-driven exciter, 125 volts; four 1125 kv.a., 3-phase, water-cooled transformers, 2400/44000 volts; two out-going 44,000 volt lines connecting to the Electric Power Company's system which now comprises about 300 miles of 44,000 volt line and twenty-two 44,000 volt sub-stations, together with several other power houses which have been described from time to time in the Electrical News.

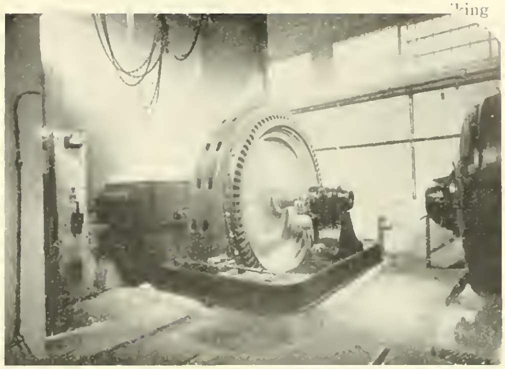
The demand for power over this area has increased at such a rate that it has also been found advisable to utilize a water development owned and operated by the town of Campbellford. To this end arrangements were made be-

Power house, Seymour Power & Electric Company

Campbellford municipal power house



Seymour Power & Electric Co.—Five 600 kw units



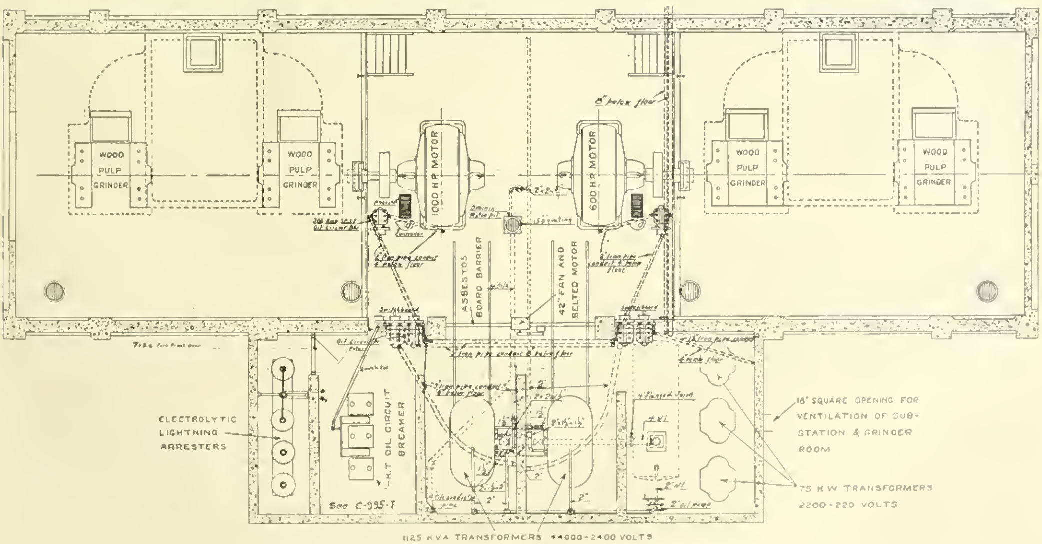
Motor equipment, Northumberland Pulp Company

tween the Electric Power Company and the town whereby a 1,000 kw. generator was installed in the town power house. The power so generated is transmitted to the step-up transforming station at the company's own generating plant at Stephens' Dam, where it is also used to feed the 44,000 volt lines of the main system. This machine is of Swedish General Electric manufacture.

An interesting feature of the power demand in Campbellford has reference to the requirements of the mill of the Northumberland Pulp Company, a subsidiary of the Electric Power Company. This mill is situated about three miles from the generating plant and current is supplied to it from the 44,000 volt line. The voltage is here stepped down to 2400 volts by means of two 1125 kv.a. 3-phase water-cooled transformers. These transformers feed two induction motors, one 600 h.p., 2400 volt unit, C.G.E. type, and one 1,000 h.p. 2400 volt Swedish General Electric unit. Both of these are direct-connected to pulp grinders. All the smaller machinery in the mill is also motor driven, including such equipment as centrifugal pumps (requiring one 25 h.p. motor direct-connected to each of two pumps); wet machines; barkers; conveyors; centrifugal screens, etc. All the smaller motors are 220 volt machines and of 75 h.p. capacity or under. Current for these is supplied through three 75 kw. 2200/220 volt self-cooled transformers.

In the initial plan of this pulp mill no special provision was made for preventing the moisture from the pulp grinders working its way back to the motor and transformer compartments and as a result difficulty was encountered in maintaining proper insulation in this equipment. The difficulty was later overcome by the installation of a 42-in. motor-driven fan located in the partition which separates the pulp mill substation from the grinder room. This fan draws air from outside the sub-station building and delivers it into the grinder room so that it now serves the double purpose of cooling the transformers and keeping the steam and moisture away from the motors and transformer equipment. The pulp company use about 2,000 h.p. continuously for 24 hours each day.

The Northumberland Paper & Electric Company, of Campbellford are another industry which have recently electrified part of their mill and now use four 50 h.p. induction motors on beaters and two 75 h.p. induction motors on Jordans in addition to several smaller motors for conveyors, etc., taking in all about 300 h.p. This is supplied by the



Layout of substation, motor and grinding rooms—Northumberland Pulp Company

...tric Power Company from the same sub-station that furnishes power to the Northumberland Pulp Company.

The value of this type of load on any electric system is shown by the unusually favorable load factor now maintained by the Electric Power Company throughout their entire system. The peak load on this system has grown very rapidly and in December, 1912, just three years after the Stephens' Dam power house commenced operation with a load of 300 h.p., the peak had grown to 15,000 h.p. with a daily load factor usually exceeding 80 per cent.

This load of 15,000 h.p. is very close to the total generating capacity of the system and arrangements have been made with the Northumberland Pulp Company, that, when necessary, their load can be pulled off for a short time when the peak on the total system threatens to overload the generators. This, at the worst, is only for a couple of hours a day during the shortest days of the winter season. Within the last few weeks the new power house at dam No. 5, at Frankford which is about five miles north of Trenton on the Trent Valley canal has been placed in commission and now contributes about 4,000 h.p. to the total generating capacity of this system. This installation consists of four 650 kw. 6600 volt, 60 cycle, 3-phase vertical shaft, Swedish General Electric generators, each driven by a 1,200 h.p. Boving turbine. Other electrical equipment includes one 75 kw. turbine driven exciter; one 75 kw. induction motor driven exciter and switchboard equipment furnished by the Monarch Electric Company of Montreal. No sub-station has been built at this point but power is transmitted at the generated pressure of 6600 volts over four circuits of 300,000 c.m. stranded aluminium cable to the transforming station at dam No. 2 which was described in the June, 1912, issue of the Electrical News. Sufficient transformer equipment has been supplied at this point to take care of all the power generated at both dam No. 2 and dam No. 5 and step it up to 44,000 volts. The recent addition at this point of a 3,000 kv.a. step-up transformer brings the present capacity to 9000 kv.a. in three 3000 kv.a. units.

Anticipating continued rapid increase in the power demand in central Ontario the Electric Power Company are also pushing forward to completion the Healy Falls power house development which is situated on the Trent River six miles north of Campbellford. At this point there is a head of 76 ft. and the power house is designed for four 5,600 h.p. turbines each of which is to be direct-connected to one horizontal shaft 3,750 kv.a. 60 cycle, 3-phase, 6600 volt generator. The equipment which will be immediately installed in this power house and which is already on order consists of two 5,600 h.p. Escher Wyss turbines; two 3,750 kv.a. C. G. E. generators; one 160 kw. turbine driven exciter, C.G.E. type; one 160 kw. induction motor driven exciter, C.G.E. type, and three 3,750 kv.a. 3-phase transformers 6600/44000 volts supplied by the Canadian Westinghouse Company. Switching equipment for the above apparatus and two 44,000 volt outgoing lines will also be supplied by the Westinghouse Company. It is expected that the Healy Falls plant will be sufficiently advanced to carry next winter's peak load.

Toronto's Hydro Electric Distributing System

By Mr. J. G. Jackson

The construction work on the distribution system of the City Electrical Department, later the Toronto Hydro-electric System, was started, so far as the general plans, etc., were concerned, in the latter part of 1908. Actual construction on the underground sections commenced in August, 1909. The major portion of the work, however, was done from 1910 to 1912.

The system consists of eight substations, fed from a 13,200 volt bus in the Toronto station (Strachan avenue) of the Ontario Hydro-electric Power Commission: a 2200/115-230 volt distribution system for general lighting, with incidental power at 550 or other voltage; a street lighting system; and a 13,200/550 volt three-phase power network.

The major portion of the distribution is accomplished by means of overhead construction. A considerable portion of the business section, however, is covered by underground.

General

In designing the distribution system, the following points were kept in view. It was necessary to supply a waterworks pumping load with a total connected capacity of 14,375 h.p., comprising 8,925 h.p. for general pumping and 5,450 h.p. for fire and other occasional purposes, the load being taken at three different stations; total maximum demand equals 7,650 h.p. A street lighting system was to be provided to supercede a system consisting of ancient arc lights, together with intermediate gas lighting. Also provision was to be made for the supplying of light and power at any point in the city so far as practicable.

The city covered an area of 28 square miles, approximately the greatest dimensions being 10 miles long and 4 miles wide, with a total of approximately 412 miles of streets. The load to be provided for on account of the waterworks and street lighting could be easily determined. For the general lighting and power load, however, it was necessary to design a system upon which it would be possible to connect with the least inconvenience almost any load which might occur. So far as any other than exceptional loads are concerned, this was best accomplished by the provision of a secondary net-work of such capacity as would be expected to supply the total load existing at any point. The fact that the distribution system was being constructed before the loads were actually secured made necessary a liberal capacity in the initial installation, as well as such flexibility as would make it possible to take care of rapidly growing loads, in any district, with the least possible delay.

Primary and Secondary Voltages

13,200 volts was chosen as the general transmission voltage, upon consideration of the distances to be covered, and in view of the fact that this voltage was being standardized for their system by the Ontario Hydro-electric Power Commission. It has also considered that 13,200 volts was sufficiently low to permit of its utilization for general distribution purposes. 2200 (or 2300) volts was decided upon as an intermediate primary voltage for lighting and power distribution, as it was intended that the feeder lengths would be sufficiently short to permit satisfactory operation with this voltage. This also made it possible to connect 2200 volt motors directly to the primary lines.

In this connection, it might be noted that an investigation to determine the proper voltage for the waterworks pumping, the motors ranging from 500 to 1500 h.p. sizes, indicated that the efficiency and cost of 13,200 volt motors as against 2200 volt motors and transformers would be practically identical, with a tendency on the part of the manufacturers to favor the lower voltage.

Secondary lighting and power voltages of 115 volt and

230 volt single phase and 550 volt three-phase, were of course determined by the voltage of the loads to be supplied.

Stations and Station Details

The eight substations provided were located at such points as would make the intervening distances as nearly equal as possible, and at such points as were suited for waterworks purposes. The station structures were erected by contract, but all electrical construction, including pipe and duct lines, cable works, switch structures, switch installation, and switchboards, including the panels, etc., were designed and erected by the staff, as it was considered that the particular characteristics in design, and class of workmanship, together with low cost and quick results could be obtained in this way.

The stations in general contain 13,200 volt switching equipment for the main feeders from the terminal station to the substation, supplying such busses in the substation, from which 13,200 volt sub-feeders were taken off, either for lighting and power transformers in the station, or for sub-feeders to other points. The 13,200 volt bus arrangement at the terminal station was laid out as a double ring. Each transformer bank of the original installation fed a separate bus section, the sections being tied by means of sectionalizing oil switches, and each feeder and transformer bank being equipped with two "H" switches to permit the selective connection of either the main or the emergency bus. This arrangement makes it possible to kill any bus without interrupting the service, and to disconnect any transformer bank feeding its bus section from the sectionalizing switch.

The 13,200 volt busses in the substations consist of two or more sections, connected by busses to switches, each section being supplied by one or more feeders, such feeders from these busses being equipped with a single oil switch, mainly of the Westinghouse "E" type.

The less importance of the substation busses, and the fact that most of the loads supplied by these feeders are fed by more than one feeder, was considered to justify the omission of an alternative bus. The bus to switches, however, made it possible to feed any bus section from other than its own particular feeder. In the case of long feeders looping through all or several sub-stations an incoming and outgoing "H" switch was provided in each station, together with a substation feeder switch, making a "T" connection to a short bus between the incoming and outgoing switches.

Brickwork and reinforced concrete slabs have been used entirely for cell construction. The size brick used not being, 8¼ in. x 4 in. x 2¼ in., standard in this country, it was necessary to have it specially burned. In view of the fact that vitrified brick of the proper characteristics could not be obtained locally, softer pressed brick was employed. No serious chipping of the brickwork has, however, resulted. The slab work was made up as required, and was principally 1:2:4 mix, 2 in. thick, and costing approximately 18 cents per square foot. Doors were made of asbestos board of ¼ in. thickness, on 16 in. x 7 ft. 6 in. frames, the panels in front of the disconnecting switches being wire glass, thus permitting easy inspection.

Busses are of 2 in. x ¼ in. flat copper, and jumpers of 1 in. diameter copper tubing 1-16 in. wall. It was considered that a more satisfactory structure, and with more pleasing appearance would be obtained by the use of brick rather than concrete, as previous experience with concrete structures had indicated that particularly accurate form work and workmanship was necessary in order to produce a satisfactory structure, and that it was more difficult to do any cutting or make any alterations to the structure at any time afterward. Considerable difficulty was, however, experienced in getting the bricklayers up to the point where they would lay a reasonable number of bricks per day. The pressure brought to bear upon them resulted in a number of visits from the "walking delegate." When it was pointed out to him, however, that the rate which the bricklayers apparently thought sufficiently great figured out to 65 bricks per day, or approximately one brick in every 7½ minutes, the result was that it was found possible to lay approximately 200 bricks per day, per mason. This, of course, included the laying of slabs, setting of fastenings, cutting for conduit work, etc.

2200 volt Black Monson slate panels are provided on the 2200 volt switchboards and high tension control panels, the 2200 volt panels being 18 in. wide, and high tension control panels 12 in. 2200 volt switches up to 300 amperes capacity, are mounted on the back of the slate panels. Masonry structures with barrier walls are provided in the basement under the 2200 volt structure for the purpose of mounting disconnecting switches, etc., and also the heavy oil switches which cannot be conveniently accommodated on the switchboard panels. Control panels carry the necessary instruments and control switches for operating the high tension equipment. A 125 volt 40 ampere-hour storage battery with a 200 ampere discharge rate for 1 minute, is provided in each station for the operation of the switches, signal lamps, and emergency lighting.

To protect the lamp circuits from high voltage during

Standard Toronto H. E. transforming station

the charging of the storage battery, all lamps are connected to a third bus, which is arranged to be ordinarily in parallel with one side of the main control bus. The throwing of the battery switch for connection to the motor-generator set when charging, separates the lamp bus and connects it to Cell 55 of the battery. All switchboard wiring is asbestos covered.

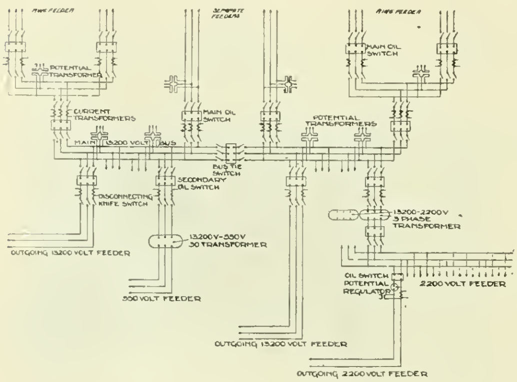
General Lighting

The average length of the feeders worked out at 12,000 feet of which 3,000 feet consists of the distributor portion, to which the transformers were connected, and 9,000 feet of feeder from this point to the substation. The simple form of primary adopted makes it possible to operate long sections of the primary as the single feeder, breaking up such sections later by simply cutting the distributor into such lengths as the load might require, and running additional feeders to these points. Comparisons of the investment and the fixed charges as against losses, resulted in the fixing of the primary size at 3/0 for an assumed loading of 180 amperes. The No. 2 secondary bus parallels the primary, the No. 2 secondary being determined by the fact that with the sizes of transformers provided for, the dropping off of one transformer

when feeding through the next transformer would, under full load conditions add only 1 per cent. to the secondary drop.

The secondary wiring on the side streets consists of Nos. 6, 4, and 2 outers, with occasional larger sizes, the neutral being almost in all cases No. 4 on the main feeders, and No. 6 on the cross streets, being mainly No. 4 on the streets at right angles with the primaries, and No. 6 on the cross streets. These sizes of secondary wiring were determined by the average loading assumed, and the allowance of a maximum secondary drop of 3 per cent. Comparisons were made between the sizes of copper which would result in this drop for the assumed loadings and larger sizes, and it was determined that this was practically the most economical point, particularly as the loadings might be different from those assumed. Any error in size resulting from this could be, in general, easily corrected when the loading developed, as double side wiring was provided for, and single side installed until the development of the load.

All transformers are provided with fuses on the primary side only, and are connected solidly to the secondary bus, which is broken at intervals, intended in general to cover 4 or 5 transformers, these secondary breaks being arranged for fusing in case it appears that any improvement in regulation or saving in capacity would result from a tie. No other fusing than for bus sectionalizing are provided on the secondaries.



Wiring diagram of typical substation

The lighting transformers in general range in size from 15 to 30 kw. capacity, the general size assumed in the layout being 25 kw. Transformers are installed as nearly as possible at the junction of the service to the cross streets with the primary lines in order to avoid drop. Neutrals are grounded at all transformer poles by means of a ¾ in. galvanized pipe driven 6 feet into the ground. As the neutrals are practically continuous, there may be a thousand or more such grounds in parallel. This has proven very effective. Ground wires are provided at each transformer pole, the transformer cases being grounded to this wire, to which the lightning arresters are also connected, thus resulting, in a direct path from the ground side of the lightning arrester to the transformer case.

Street Lighting—Overhead District

It was determined to use tungsten street lighting, mounting a lantern fixture on the concrete poles. For this purpose a ½ in. pipe was provided in the pole, with a nipple extension for securing the fixture and carrying the wires. A condulet was provided at the top of the pole. A series multiple system using 10 lamps on 220 volts was originally contemplated, thus requiring 2 outers and a series wire. Owing in part to the lack of flexibility of this system, as well as to the probability that the standard 110 volt lamp would improve, a straight multiple system with 110 volt lamps was installed.

The wiring to the lamp consisted of two extremely flexible No. 16 rubber covered wires, of 31 strands, tied solid to the neutral and one of the outer wires of the street lighting secondary. A three-wire secondary was required, the neutral being common however, with the residence lighting secondary. All secondaries are No. 6, with the exception of the common neutral. All primaries are No. 2. The distance between feeders is 3,000 feet. Transformers are mostly 10 and 15 kw. There are 16 feeders of 200 amps. normal rating. No regulators are provided.

This system compares favorably with the series wiring for an arc or other series system, although two additional wires are required besides the tie to the residence lighting neutral. While a single wire would in some cases be possible for the series system, the 200 kw. or more capacity of the feeder greatly reduces the number of wires required for the return circuit to the station, and as this comprises a very considerable part of the total wiring, the saving in pole space seems apparent.

Overhead System

The overhead system consists mainly of the 13,200 volt feeders on wooden pole lines; the 2200 volt feeders, covering approximately 20 per cent. of the streets and on wooden pole lines; the secondary lines, which, in general, are of concrete poles.

The primary lines on parallel streets, such as Queen St., College, Bloor St., Dupont, etc., spaced approximately 3,000 feet apart, carry both street and general lighting primaries, and are provided with three six-pin cross arms. The primaries on streets approximately one-half way between these points carry only general lighting primaries, and are provided with two six-pin cross arms. The primary pole lines have been constructed, in practically every instance, to overbuild any obstruction such as trees and lines of other systems.

It has been possible to build the secondary lines on short poles, as possible contact of 220 volt circuits with trees, etc., would not result in any particular troubles.The short cross arms or brackets on the concrete poles are provided with 6-pins, of which the upper and outer on the street side are used for street lighting, the three on the inside being employed for general lighting, and the neutral for street lighting as well. The sixth pin makes it possible to run a power leg, giving three-phase 230 volts with the two outer general lighting wires.

All wooden poles are stepped. Cross arms are treated in a carbolineum tank. All hardware used is heavily galvanized, and in general is heavier than that ordinarily listed for this purpose. All cross arms are held with ¾ in. through bolts. Poles are painted with a single coat of good paint. Specifications for wooden poles are practically standard. An effort has been made to obtain straight poles of good appearance.

The fact that the streets were occupied on both sides by other lines before this system was started, resulted in considerable difficulties in obtaining clearances for poles and lines. In the case of transformers, in order to avoid entanglement with other lines, the primary and secondary lines were brought down to the transformer from the top of the pole in 1¼ in. conduit, with condulet openings at the top and bottom. On the primary side, the leads to the conduit consist of rubber insulated spark coil wire, tested to over 26,000 volts. This is tied directly to the primary overhead, the fuses being placed at the transformer. The size of wire is such that it was expected, in case of any trouble, it would be possible to burn out the spark coil wire at less than the capacity of the feeder. It may be remarked that, although

this produces a very neat transformer connection, considerable trouble developed later, owing in a large part to the defects resulting from inferior wire having been installed owing to various reasons.

Breakers in secondary lines were made by means of egg-shaped porcelain insulators, the breaks in bus lines being arranged with lugs, so that an open link aluminium fuse could be used to bridge the insulator. No. 6 galvanized iron ground wire was used on transformers, connecting to the ground pipe driven in at the base of the pole.

The secondary fuses have been omitted as far as possible on the street lamps. It was considered at an investment of 25 cents per pole for fusing, totalling about $9,000, that the annual fixed charge on the investment would be very considerably greater than the actual damage due to burn outs of lamps and wiring resulting from lack of fusing. In addition to this it was felt that a multiplicity of secondary fuses would result in only a greater number of points from which trouble could arise.

Typical sub-station for large consumer—Built of 1 inch concrete slabs

All connections at substations to the overhead 22000 volt lines are made underground in cable, with potheads at the terminal poles. No trouble has been experienced on these cables.

Lightning arresters are installed at every transformer, and at the junctions of the overhead with the underground, except that transformers in the central district of the city are not provided with lightning arresters, on the assumption that the buildings and columns of heated air and smoke would effectively shield these locations. This has apparently been demonstrated to be correct.

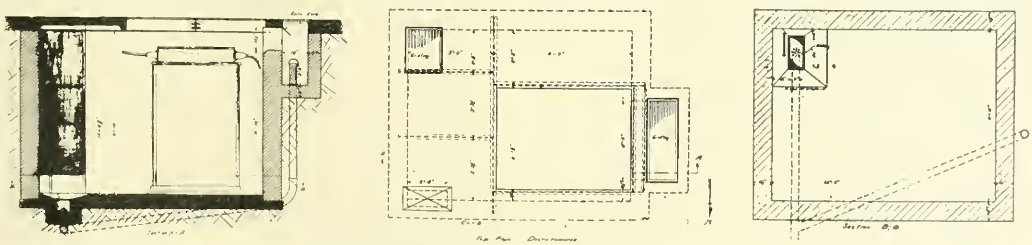
13,200 volt pole lines have been constructed in so called "Ring Mains" consisting of two circuits of 250,000 c.m. cross section aluminium, 13,200 volt lines. The construction adopted consists of three cross arms, with the lines of each circuit arranged vertically, and with similar phases on each arm, the result being that wires thrown over the line will not necessarily result in a short circuit or other trouble. A No. 2 aluminium ground wire mounted in a bracket and clamped to the pole top is carried throughout the entire distance. Two additional No. 2 aluminium ground wires are carried on the cross arms on either side of the pole for one-half mile in either side of the station. Ground wires are grounded at every pole by means of a No. 6 galvanized iron wire running down the pole and tacked to it. These wires are connected to all the pole hardware, with the exception of the steps, and are grounded to a 1 in. galvanized iron pipe, 7 feet long, driven 6 feet into the ground.

Entrances to the substations from the 13,200 volt overhead lines are made by means of passing through concrete roof entrances, with cast concrete caps. The wiring on the roof is carried on pipework. No difficulties have been experienced from leakage or condensation at the roof entrances.

Underground Construction

A total of approximately 600,000 duct and pipe feet of conduit have been installed, in lines ranging from single pipe to 36 duct runs, and there are 171 manholes. The conduit structures in general are only three ducts in width. For duct work 3½ in. single clay duct has been employed. The ducts are surrounded by 3 in. walls, with 4 in. base and top, of 1:3:5 concrete mixture. Adjacent ducts are staggered, and all ducts are laid in a full bed of mortar of 1:2 mix, thus resulting in an extremely strong structure. No mandrils were employed in the laying of ducts. Ducts were tested and cleared, so far as possible, the same day they were laid, to prevent the formation of any obstructions. All conduit runs were graded in one direction only, with a minimum grade of 2 in. to 100 ft. No high or low spots were allowed between manholes.

Manholes were designed, as far as possible, to prevent sharp bends in the cables. For this reason, in practically all cases a 14 in. sweep in the wall was preserved at duct entrances, so that no corners were produced into which or about which cables could be bent. All manholes were provided with sewer connections, and with a ground pipe driven 6 feet into the soil under the manhole. All manholes are of brick construction, with 8 in. concrete roof, and 6 in. concrete floor. Manhole covers are of cast iron, provided with a number of holes to assist in ventilation. The average cost of conduit construction of tile duct has been approximately 20 cents per foot.



Typical transformer pit showing plan of pit and ventilating system

Cables in manholes are carried on, mainly, a single row of cast iron hangers. All cables 2200 volt and higher are wrapped with ¼ in. asbestos tape, held by a fireproof cement. The asbestos covering of the 13,200 volt cables is painted red. No. 2 copper ground wires are wired to all cables and can be connected to the ground pipe, or grounded by the waterpipe where this is available, if tests at any time show that this is necessary. Cable records are made on cards showing manhole faces, etc. All cables are tagged.

550 Volt Network

For dense power loads, covering a considerable district,

there is a 550 volt net work lay-out, fed by 13,200 volt sub-feeders, fed from the sub-station busses. Each feeder is controlled by one oil switch on the sub-station bus, and terminates in a transformer pit, supplying a 13,200/550 volt transformer of minimum size of 500 kw. On the secondary side these transformers are provided with main disconnecting blades, and branch fuses mounted in feeder pillars.

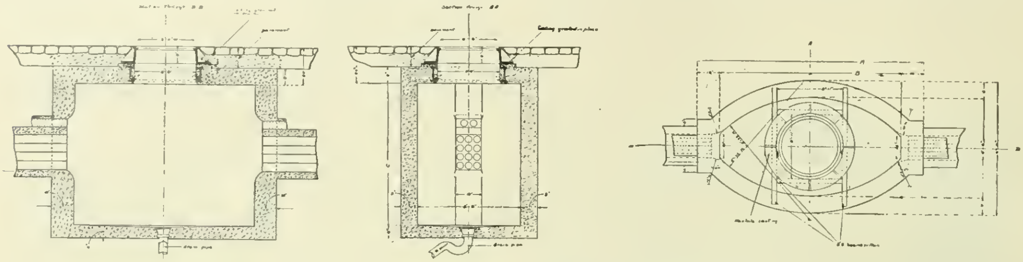
The transformers are mounted in special transformer pits, arranged with air inlet and down shaft on one side of the pit, and a ventilator on the top at the opposite end, the air inlet and outlet being covered by iron gratings. These are built under the sidewalks or in other available spaces.

Transformers employed are water cooled, but results obtained in ventilation of these pits indicate that a self-cooled transformer could be used. It was originally considered desirable to arrange for the drainage of the water coils of the water-cooled transformers mounted in these pits, so that the water would not freeze up in winter time. To determine the variation in temperature, recording thermometers were placed in manholes in which no cables were being operated, and the minimum temperature of 31 F. to 32 F. degrees were obtained, with the temperatures down to 10 degrees below zero outside.

This system of 13,200/550 volt distribution, with secondary network and transformers, is thought to present considerable possibilities.The transformer capacities and cost of same, together with transformer pits, fuse boxes, etc., are considerably less employing units of 500 kw. or more than would be the case with the usual primary distribution and transformers averaging not more than 50 kw. in size. The size as well as the cost of a pit for a 500 kw. transformer would not be very much more than in the case of a 50 kw. transformer. The boxes also, while somewhat more expensive, would be very much less in number. It is also possible to do with somewhat less transformer capacity than would be possible in cases even with a secondary network fed with a large number of small transformers. The transformer capacity as compared with small transformers each supplying a separate secondary, is, of course, very much less.

Primary losses and drops with 13,200 volts are almost negligible. Transformer efficiencies can be maintained at approximately 98 per cent. The costs per kilowatt are approximately one-half that for transformers of 25 to 50 kw. capacity. Very good secondary regulation can be maintained by the dropping in and out of feeders with variation in load, as would be in the case in a d.c. network. As the load falls off transformers can be dropped out with the result that the remaining transformers continue to be fully loaded, or nearly so, thus eliminating transformer regulation. A secondary regulation within 2 per cent. is considered quite possible. Voltage regulation at the station 13,200 volt bus could not, of course, be compensated for in this way to any extent. The switching in and out of transformers and feeders on the primary side of the variation in load obviously would produce very little effect on the cable or transformers; in fact it appears probable that the distribution of a system of this sort would be considerably less as a result of the common secondary network.

A No. 4 13,200 volt paper-insulated cable, approximately 2 in. in diameter is employed on the feeders to these 13,200/550 volt transformers. The cost of this cable is approximately the same as for a 3/0-2200 volt cable, which has approximately 1-3 of the capacity. The I^2R losses and drops also, over the 13,200 volt cable, are obviously very much less. The difference in cost for cables for duct lines only 3,000 feet



Toronto's underground conduit system—Standard two-way manhole

in length, are found to amount to $7.50 per kw. delivered, in favor of 13,200 volt feeders. The network system of this sort will, of course, increase in efficiency and possibilities of regulation as the number of feeders is increased. It is considered quite possible to obtain an efficiency from the sub-station to the consumer's service of in the neighborhood of 90 per cent. when fully loaded. The reduction in coil losses by the elimination of the unnecessary transformer is also an advantage.

This 550 volt network provides a voltage at which motor loads can be taken off directly, and which can be considered as a primary for lighting services, individual transformers being connected to the 550 volt lines.

A very good advantage resulting from the employment of this voltage as a primary rather than from a higher voltage, is that it is quite possible for a jointer to open up a three-phase cable and connect up a service to a transformer without any very difficult precautions. All jointers are equipped with rubbers boots without nails, and with rubber mats upon which they sit, on the edge of service boxes, etc. The 550 volt system is not grounded directly, but is connected to earth through 550 volt lightning arresters or spark gaps.

Summary of General Data

Length of city	10 miles
Width	4 miles
Length of streets	412 miles
Total poles required	40,000
Concrete	30,000
Wooden	10,000
13,200 volt pole lines, including Island,	20 miles
2200 volt primary pole lines	74 miles
Duct, pipe and laterals	599,271 feet or 113 miles
Lanterns	39,000
Cluster lights	500
Underground cable, total	50 miles
Overhead wire, including secondary and primary wiring	4,500 miles (approx).
Sizes of wire and cable:—	
Wire, 13,200 volt overhead	250,000 c.m. aluminium
	No. 0 aluminium
Wire, 2200 volt overhead	3/0 copper
	No. 2 copper
Wire, secondary.	No. 6, No. 4, No. 2 & 250,000 c.m. cop.
Cable, 13,200	No. 3/0 and No. 4 copper
Cable, 2200 volt	No. 3/0 and No. 2 copper

Effects of Temperature on Insulations

By C. P. Steinmetz and B. G. Lamme*

The problem of permissible temperature limits in electric apparatus is largely that of the durability of the insulation used. As this may consist of materials of widely varying heat-resisting qualities, the problem resolves itself into one of consideration of the properties of the materials themselves.

The durability of insulation may be considered from two standpoints, the mechanical and the electrical. Tests and experience have shown that temperatures which may ruin the insulation from a mechanical standpoint, may not radically affect its di-electric strength. This is particularly true with moderate voltages where the insulation serves largely as a separating medium. The purpose of the insulation usually is two-fold; First, it must serve to separate, mechanically, the electric conductors from each other, and from other conducting structures, and second, it must withstand the voltage between the electric conductors and between the electric circuits, and other conducting parts. In lower voltage apparatus, usually only the former function applies, as the mechanical separation is more than sufficient to withstand the voltage used. The dielectric strength of the material is, however, of first importance in high voltage apparatus.

A great majority of the electrical "breakdowns" on low voltage apparatus is due to mechanical weaknesses, as far as the temperature problem is concerned; that is, high temperatures may make the insulation brittle, or crisp, so that it may flake off, or powder, or crack, or be crushed by mechanical action, thus allowing the conductors to make contact with each other or with adjacent conducting material.

The "life of insulation" is an indefinite term and must be defined in time, mechanical strength, absence of foreign materials of a conducting nature, etc. Almost all insulating materials will be somewhat affected in time, and many of them tend to become dry and brittle. The rate at which deterioration occurs with any given material, is some complex function of the temperature and of other conditions.

Classes of Insulations

Insulations may be classified under three headings, depending upon their heat-resisting properties. However, all such classifications must be relative, for no absolute limit can be fixed, as there is no definite point at which injury or destruction can be said to take place.

The usual insulating materials can be considered as included in three general classes:

Class A. This includes most of the fibrous materials, as paper, cotton, etc., most of the natural oil resins and gums, etc. As a rule, such materials become dry and brittle, or lose their fibrous strength under long continued moderately high temperature, or under very high temperature for a short time.

Class B. This includes what may be designated as heat-resisting materials, which consist of mica, asbestos, or equivalent refractory materials, frequently used in combination with other supporting or binding materials, the deterioration of which, by heat, will not interfere with the insulating properties of the final product. However, where such supporting or binding materials are in such quantity, or of such nature, that their deterioration by heat will greatly impair the final product, the material should be considered as belonging to Class A.

Class C. This is represented by fireproof, or heat-proof materials, such as mica, so assembled that very high temperatures do not produce rapid deterioration. Such materials are used in rheostats and in the heating elements of heating appliances, etc.

* Presented before A. I. E. E. New York Convention

All the above are relative terms. The first class, for instance, represents materials which are really more or less heat-resisting, but which deteriorate at lower temperatures than those in the second class, which are defined as heat-resisting. Also, the fireproof materials of the third class are not strictly heat-proof or fireproof, but will simply withstand very high temperatures for relatively long periods without undue deterioration.

In Class A, the materials appear to have a very long life (or an almost indefinitely long life, aside from mechanical conditions) if subjected to ultimate temperatures which never exceed 90 deg. Cent. Also, they appear to have a comparatively long life, even at ultimate temperatures as high as 100 deg. Cent. At materially higher temperatures than 100-deg. Cent., the life is very greatly shortened, and temperatures of 125 deg. Cent. will apparently ruin the insulation, from a mechanical standpoint, in possibly a few weeks, if such temperature is maintained steadily. However, for low voltages, the insulating qualities may still be very satisfactory, even at this temperature, and therefore the destruction of the insulation is purely one of injury or breakdown from the mechanical standpoint, as stated before. Temperatures as high as 160 deg. Cent. on such insulations for a considerable period may not entirely destroy their insulating qualities, although, mechanically, such temperatures appear to be impracticable, except for very short periods.

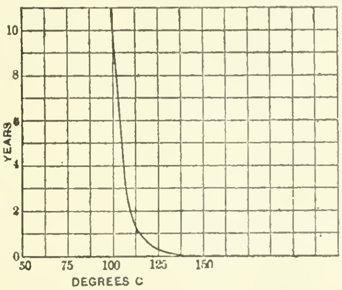


Fig. 1.

In order to illustrate the relation between the possible life and temperature of Class A insulation, Fig. 1 is shown. This must not be taken as representing actual results, but is simply intended to illustrate, in a very approximate manner, the very great shortening of the life of insulation by increase in temperature.

It may be assumed that at very high temperatures, the insulation will have practically the same life, in actual hours of high temperature operation, whether the temperature is applied continuously or intermittently. For example, if an insulation has 10,000 hours life with a certain high temperature continuously applied, it is assumed that it will also stand the same temperature for 10,000 hours in short periods, provided the intermediate temperatures are low enough to represent an indefinitely long life. It is probable that under intermittent condition, the life will really be slightly greater, due to the fact that depreciation will be largely mechanical, and the insulation may "recover," in some of its mechanical characteristics after each period of high heating.

If, therefore, high temperatures are reached intermittently, with intermediate periods of lower value but still high enough to shorten the life of the insulation, it may be assum-

ed that the total life of the insulation is the resultant of the life under the two temperature conditions.

In heat-resisting materials, such as those of Class B, temperatures of 125 deg. Cent. are comparable with 85 deg. Cent., or 90 deg. Cent. in Class A, and 150 deg. Cent. in the former is comparable with 100 deg. cent. in the latter. Fig. 2 illustrates very approximately the life-temperature curve of such insulations. As in Fig. 1, this should not be taken as an exact representation of the actual life. Due to the greater heat-resisting qualities of such materials, it appears that relatively higher temperatures are not as quickly harmful as in the first class.

In Class C materials, it is difficult to give any reasonable indication as to the limits of temperature, except that very high temperatures (practically up to the point of incandescence) are found in some heating appliances.

Temperatures and Flow of Heat

As the insulation, in itself, is not usually the seat of generation of loss or heat, it is the temperature of adjacent materials which must be considered in defining the conditions in the insulation. The temperatures of the adjacent materials should therefore be considered only in so far as they affect the insulation itself, and where such temperatures do not affect the insulation, or the life of the apparatus, or its normal performance, they are immaterial.

Considering the influence of the temperatures of the adjacent media, the direction and amount of heat flow must be taken into account, as the maximum temperature in the in-

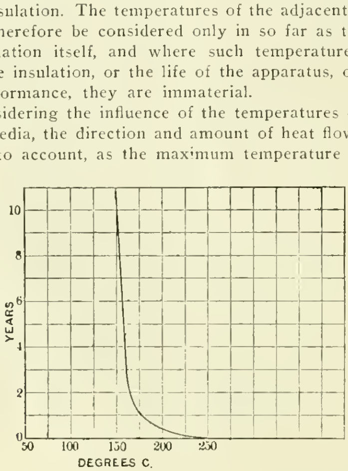


Fig. 2.

sulation is dependent upon these. In the case of armature windings, for instance, the heat flow may be from the buried portion of the coils toward the end windings. It also may be from the buried copper through the insulation to the armature teeth, or there may be a reverse heat flow from the iron to the copper, depending upon the various factors of construction, heat conductivity of the materials, amount of heat generated in the various parts, ventilation, heat dissipation, etc.

Depending upon conditions of heat flow and distribution, various methods of temperature determination may be used. No method is accurate, unless all the conditions of heat flow are accurately known, which is never the case in commercial machines.

The difficulties in the problem of commercial temperature determination are illustrated by Fig. 3.

In the figure, a represents the temperature inside an armature coil, b the temperature between the insulation and the iron of an armature tooth, c that in the body of the tooth, and d that in the body of the core at some point back of the coils and teeth. Let the temperatures at no load be represented on the ordinate A. Then, at some load, represented by ordinate B, the relations of the various temperatures have changed. At C, D and E, there are still greater changes, depending upon the heat generation and distribution. If the rated capacity of the machine is at E, for instance, then the armature copper is hotter than the iron, while if rated at B, the reverse would be true. Obviously, no rule can be formulated to cover these various conditions in different machines, nor even in a given machine, unless all the heat generation, distribution, and dissipation characteristics are known. Obviously, as far as the insulation is concerned, the temperatures of a and b are the only ones which need be considered.

All temperature determinations of a commercial nature, are necessarily approximations, or relative indications, upon which proper margins must be allowed for the ultimate temperature possibly attained. Therefore, in apparatus where there are liable to be discrepancies of 10 deg. between the measurable and the actual ultimate temperatures, a limit of 90 deg. cent. should be allowed by conventional temperature measurement on insulations in which 100 deg. is set as the maximum temperature with a reasonable length of life.

The conventional methods of temperature measurement, as by resistance, and by thermometer, do not usually give the maximum temperature, but give either the average, or the outside surface, values, and, when measuring the temperature by these methods, which are the only ones generally applicable, an allowance must be made in windings for possible local higher temperatures. These methods apply especially to those machines of moderate or low voltages in which the insulation is relatively thin, so that the heat gradient from the inside copper to the outside surface is small. Also, they apply particularly to those machines in which the conditions of ventilation are not normally difficult, and in which a fairly thorough distribution and dissipation of heat occurs among the various parts, such as in ordinary direct-current armatures, induction motors primaries, stators and rotors of moderate speed alternators in which the width is relatively small compared with the diameter, etc.

As the ultimate temperatures obtained by the apparatus depend upon its rise above the room temperature, or that of the cooling medium, and as such temperatures may vary over a wide range, it is not practicable to specify or guarantee ultimate temperature of apparatus without also specifying the elements upon which it depends. This, therefore, results in specifying the temperature rise in relation to that of the cooling medium.

While most apparatus operates at materially lower cooling temperature than 35 deg. cent. to 40 deg. cent., yet such temperatures are sometimes reached for considerable periods of time in steam stations, and it appears therefore as justifiable to choose the permissible temperature rise, such that, at room temperature of 35 deg. cent. to 40 deg. cent., an ultimate temperature of 85 deg. cent. to 90 deg. cent. by conventional methods of measurement, is not exceeded. This means, therefore, a temperature rise of 50 deg. cent. with conventional methods of testing, such as by increase of resistance, or by thermometer, in those insulations which can stand a continuous ultimate temperature of 100 deg. cent with a comparatively long life. This allows an excess of 10 deg. cent. to 15 deg. cent. for local spots, or for the temperature gradient through the insulation. A less allowance should be made for this difference when methods of temperature measurement other than the conventional are used, and which approach more closely to the highest temperature actually attained.

When the above temperatures are liable to be materially exceeded for long periods, heat-resisting insulation of class B is recommended. With such materials, a temperature of 125 deg. cent. is comparable with 85 deg. cent. to 90 deg. cent. in the materials of class A. Therefore, on this basis of a room temperature at 40 deg. cent. or 45 deg. cent., rises of 85 deg. cent. or 80 deg. cent. should not be considered harmful. However, in those special cases where the conventional methods may not sufficiently approximate local high

temperatures, as may be the case in large turbo-generators, or in wide core alternators of large capacity, the rises of 80 deg. cent. or 85 deg. cent. should not be specified by resistance or thermometer, but preferably some lower temperature such as 50 deg. cent., thus allowing a very considerable margin for local higher temperatures. In such apparatus with the righer temperatures, which requires class B insulation, there is liable to be less uniformity of heat distribution.

If special methods of temperature measurement, such as exploring coils or thermo-couples are used in such apparatus, the temperature limit of 125 deg. cent. should be considered, and not the conventional 50 deg. cent. rise. In those machines of this class which have relatively thick insulation, and consequently may have a high heat gradient between the copper and the iron, (depending upon how much heat is flowing from the copper to the iron) an ultimate temperature of the inside insulation of 150 deg. cent. is considered as the limit, this being comparable with 100 deg. cent. with insulations of class A.

In certain classes of apparatus which are artificially cooled by air from outside the room, the cooling is accomplished partly by dissipating heat to the artificial air supply, and partly by dissipation into the surrounding room. If the temperatures of the cooling air and of the room are widely different, the resultant of the two temperatures should really be taken as that of the cooling medium.

The variation of the temperature rise has heretofore been considered as having a definite relation to the temperature of the cooling medium. However, it appears that it does not follow any definite simple law, but it is sometimes positive and sometimes negative, so that no satisfactory correction for room temperature is possible at present. It is therefore desirable to make the temperature tests at a room temperature as nearly as possible to some specified reference temperature, so as to make any temperature correction negligible. The reference temperature in the guarantees should therefore be such as can easily be secured; that is, it should be the average temperature of the places at which the apparatus may be operated. This is from 20 deg. cent. to 25 deg. cent., and as it is easier to raise than to lower the room temperature, the upper figure is advisable as a reference value. This reference temperature therefore should be chosen as 25 deg. cent., which is in accordance with the previous A. I. E. E. standard.

Measurement of Temperature

In the conventional methods of temperature measurement, by thermometer, and by resistance, many conditions should be taken into account, and good judgment is required, in all cases, or fallacious conclusions may be obtained.

There are many conditions which affect both the accuracy of the resistance and the thermometer methods of measuring temperature. The resistance method measures only the average temperature rise, and not that of local hot spots. However, it measures the internal temperature of windings, and therefore no correction is required for the temperature gradient through the outside insulation. The proposed margin between the result by the conventional method, and the actual temperature can therefore be allowed, in the resistance measurement, as the difference between the warmer and the average temperatures in the windings. In the resistance method of measurements, the rate of transfer of heat from one part of the winding to another will not greatly affect the result, as the measurement indicates an average temperature, which is that obtained if the heat were equalized throughout the winding. However, the rate of flow of heat from the windings through the outer insulation to other parts, will affect the temperature measurement by resistance, and preferably the measurement by this method should be taken during operation in those parts where this is practicable, as in field coils, and some other instances. In those parts where the resistance cannot be measured during operation, this should be done as quickly as possible after shut-down, and the time taken to shut down the apparatus should not be unduly long. Preferably, during shut-down of rotating apparatus the normal current should be maintained on the apparatus until at least a relatively low speed is obtained. This would represent only an average condition, as the ventilation at lower speed is very greatly decreased, while the losses in the windings will remain normal, thus tending to give an increased temperature in the windings. It would be difficult to fix any definite rule which would give the exact temperature conditions during shut-down.

In the measurement of temperature by thermometer, considerable judgment is required. Wherever possible, the temperature should be taken during operation, but the thermometer with its pad should be so placed that it does not interfere with the normal air circulation. In thermometer readings, as usually obtained on windings, the heat gradient

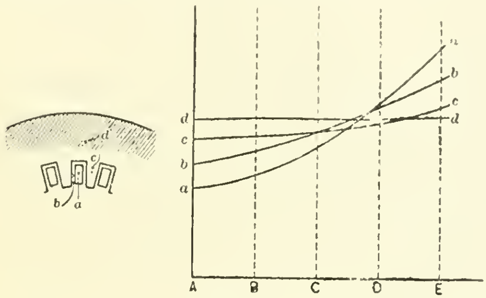


Fig. 3.

through the insulation must usually be allowed for, this being 10 deg. to 15 deg. as previously defined. However, depending upon the method of taking the temperatures, this allowance should vary over a considerable range, depending upon whether or not the method of measurement approximates the actual internal temperature. For instance, the total heat gradient from the inside copper to the outside air will be that through the coil insulation, plus the thick covering pad over the temperature bulb. If the gradient through the covering pad is very large compared with that through the insulation, the thermometer may indicate almost exactly the internal temperature of the copper, that is, the heat gradient through the insulation to the themometer, may be relatively small compared with the total gradient to the air. This is particularly true where the thermometer rests on a metallic seat which covers a considerable portion of the coil surface. In this case, the heat which affects the thermometer bulb will pass through a relatively large section of surface, with a correspondingly small drop in temperature, so that the bulb more closely approximates the temperature of the inside copper.

Where there is local heating in the windings, and a consequent liability of rapid transference of heat to other parts, the results obtained by the thermometer method will vary to some extent with the rapidity with which the actual measurement is made; that is, the more quickly the thermometer can be brought up to the full temperature, the more accurately the temperature of the hottest part is determined. With a very rapid method of measurement, it may be possible to measure practically the internal temperature of the copper of the winding before any great heat transference or dissipation has occurred. In such cases, obviously, the full allowance for the usual temperature margin should not hold. It should be fully understood that it is the ultimate tempera-

ture, and not the temperature rise, which should be considered as the limiting condition, and that the measured rise, plus the allowances for temperature gradient, plus the measured room temperature, is simply an indication of the possible ultimate temperature. By whatever method the temperature measurement is made, in all cases the results may be considered as more or less approximate, and in the end, it is the manufacturer who must supply the necessary margin over the approximate measurement, in order to make the machine safe.

A blind adherence to some particular rule or method of taking temperatures, may lead to fallacious results in some instances. In armature windings, in particular, incorrect readings may be obtained after shut-down. For example, if the armature iron back of the armature teeth were hotter than the armature teeth and coils during operation, then the temperature to which the insulation is subject during operation may be considerably lower than that in the hottest part of the machine, due to the ventilation conditions when running. However, upon shut-down, the temperature at the insulation may rise to that of the hottest part of the machine, and therefore a false temperature, by any method of measurement, might be indicated.

Recommendations

That with class A insulation, 90 deg. cent. be taken as the ultimate temperature limit, as indicated by conventional methods of measurement, or those which give similar results, and that 100 deg. cent. be considered as the maximum ultimate temperature permissible in the insulation, where a comparatively long life is a requirement.

That 40 deg. cent. be taken as the limiting temperature of the cooling medium, or room, and that, therefore, 50 deg. cent. be the permissible rise by conventional methods of measurement, with class A insulation.

That 25 deg. cent. be taken as the reference air temperature. With the permissible 50 deg. cent. rise, this gives 75 deg. cent. as the average operating condition, by conventional methods of measurement, or 85 deg. cent. actual temperature, when the usual margin represented by the temperature gradient is added.

An exception to the rise of 50 deg. cent. can be made in those cases where space or weight limitations are such that higher temperatures, with consequent reduced life, are commercially economical, such as in railway motors. In such cases, with class A insulation, a rise of 65 deg. cent. with reference air at 25 deg. cent. is at present accepted as good practice.

With class B insulations, 125 deg. cent. be taken as the ultimate temperature limit, as indicated by conventional methods of measurement, or by equivalent methods, and 150 deg. cent. be considered as the maximum ultimate temperature permissible in the insulation. It follows therefore that 80 deg. cent. to 85 deg. cent. rise is allowable, with such insulations, by the usual methods of measurement.

No temperature correction should be made for variation of the cooling temperatures from the reference temperature of 25 deg. cent.

When the method of temperature measurement shows the highest temperature actually obtained in the insulation, the maximum temperature specified for the given type of insulation should hold.

The Bell Telephone Company have purchased some property on St. Urbain street, Montreal, for the erection of a branch exchange, at a cost of $100,000. Plans are being prepared for this building which will not be erected until next year. It will serve parts of the division known as the "Main," "Uptown" and "East."

Telephone Developments

According to the statement of the Bell Telephone Company of Canada for the year 1912, submitted at the annual meeting in Montreal, the gross earnings totalled $7,638,304, an increase of $1,161,456; the operating expenses were $2,647,862; maintenance $1,403,339; depreciation $1,535,000; taxes $171,917. The net earnings were $1,880,185, an increase of $222,370. The balance after bond interest totalled $1,598,095 as against $1,425,835, and the surplus, after payment of dividends, was $449,133, as compared with $425,835. From this surplus $5,335 was charged off patent account, and $100,000 added to employees' benefit fund, leaving a balance of $343,774 to be carried forward. The balance on surplus account was $429,189.

Over 31,000 names were added to the list of subscribers during the year. At the close of 1912 it had in operation a total of 192,748 telephones, operated through 456 exchanges; it owned and operated 64,321 miles of long distance wire on 9,136 poles, and 2,784 miles of wire in underground and submarine cables.

Telephone Despatching

The Grand Trunk Railway Company have now completed the telephone system of train despatching between Montreal and Belleville. Between Montreal and Toronto there remain some forty miles of line to be strung, but between Toronto and Sarnia the line is practically complete. Mr. P. Hinton, general passenger agent for the Grand Trunk Pacific, reports that operation of trains by telephone is now in force on all the branch lines west of Edmonton. The experiments made have been successful and the system is in permanent use. On the Lake Superior branch the latest and most modern telephone apparatus has been in use for some time past, and similar equipment will shortly replace that now in use on the main line west of Edmonton.

Telephones in Elevators

Use of the telephone is constantly becoming more extended. A recent installation of considerable interest was that made by the Western Electric Company in the Woolworth Building, New York. That structure is fifty-five storeys high, and its fifteen elevators are each equipped with a telephone set and a loud talking receiver. These are connected with a main switchboard, operated by the elevator starter, on which the position of every elevator is constantly shown. The starter can switch his telephone in on any floor and get any one of his men to stop or start at any time. There is also a connection with the engine room by which the starter, in case of accident to engines or to elevators, can immediately be notified.

Can Erect Poles

By an order of the Railway Commissioners the Bell Telephone Company is to be allowed to erect poles on 23 streets in Montreal. The case for the company was that the cost of serving customers by conduits was prohibitive, and that objection was made to the erection of poles on private property. The Electrical Commission submitted plans showing that the problem might be solved by the building of manholes three hundred feet apart and from there using the trees on the streets in question from which to drop the wires for the supply of the customers. Objection was taken to this, and the Chairman, while allowing the use of poles on 23 streets, asked for information regarding other thoroughfares.

ELECTRIC RAILWAYS

New Barns of London & Lake Erie Railway Company

The London & Lake Erie Railway Company recently completed the construction of their new car barns which will accommodate their complete passenger rolling stock of sixteen 55-foot cars. This line operates between London and Port Stanley with 22 miles of line passing through St. Thomas, some nine miles south of London, and at this point the new car barn is situated. The line is operated since the new year by power supplied by the Hydro-electric Power Commission of Ontario, which is stepped down through 13,000/380 volt transformers. Motor-generators, the motors of which operate at 380 volts, supply current to the street railway system at 650 volts d.c.

The main car barn is 210 ft. x 95 ft. and the whole of the company's passenger rolling stock, viz., sixteen 55-foot cars, can be accommodated. This building has two pits, one the whole length of the building and the other half the length, which enable easy inspection of the cars. To the east of the main building and under the same roof are the master mechanic's office, a large store room in which car repairs are kept, an armature winding room, a well-equipped blacksmith shop, carpenter shop and general repair shop. Near the general repair shop is a wheel pit running at right angles to the inspection pits which allows the easy removal of wheels from the cars. The main barn is fitted with an overhead travelling crane.

On the west side of the main building are a well-equipped lamp room and motormen and conductors' waiting room, fitted with lockers. The boiler room is in the basement and contains a 40 h.p. boiler for heating purposes. Other rooms include a linemen's room, a sand drying room with a hopper in which a car load of sand can be dried at one time, and a coal room. A special room is also supplied for washing the cars.

Just outside the car shed is a second building which houses the sub-station equipment and includes also a large freight shed, freight offices, ticket offices and waiting room. The freight shed has over 1500 feet of floor space.

Growth of Calgary System

On July 5, 1909, with a population of approximately 35,000, the city of Calgary first placed its municipal railway system in operation. At that date there were two cars in operation. The phenomenal growth of this city is shown by the following statistics: Cars operated on July 5, 1909, 2; July 1, 1910, 15; July 1, 1911, 22; July 1, 1912, 48. The number of miles of track on corresponding dates were 3, 16½, 26½, 54. The number of employees, 15, 62, 102, 246. In 1910 the revenue was $213,807; in 1911, $368,869, and in 1912, $606,083. During the present year seventeen miles of track will be constructed with additional car barn equipment. Also a number of cars will be added to rolling stock which will bring the total at the end of 1913 to 78 cars. The population at the present time is placed at 75,000. Mr. Thos. H. McCauley is superintendent of the Calgary street railway system.

New Cars for Regina

The Regina street railway system have just added to their present rolling stock eight double truck street cars built according to the following specifications by the Preston Car & Coach Company: Length of car body, 28 ft.; length of front vestibule (outside), 5 ft.; length of rear vestibule (outside), 7 ft.; projection of bunters, 6 in.; length of car over bunters, 41 ft.; width of car over side sheathing, 8 ft. 6 in.; width of car inside, 7 ft. 8 in.; height of car from bottom of sill to top of roof, 8 ft. 9 in.; width of front vestibule door, 30 in.; width of rear vestibule door, 48 in.; seating capacity, 38 people; cross seats and rear end longitudinal seats. Trucks, Brill 27-G.1., wheel base 4 ft. 6 in.

Electric equipment.—Four 40 h.p. 101-B. Westinghouse equipments; four 40 h.p. G.E. 80a Canadian General equipments, with K-28 controllers. Westinghouse S.M.1 straight air brakes.

Berlin and Waterloo Additions

The Berlin & Waterloo street railway system recently added two Preston cars to their rolling stock. The specifications of the cars are as follows: bodies 30 ft. 10 in.; front vestibule 5 ft.; rear vestibule 7 ft.; no bulk heads in either end, arranged for pay-as-you-enter; longitudinal seats with an extension running out into each vestibule which can be folded up when not required; cars are finished in cherry, both inside and out, natural finish; upholstered in rattan; mounted on Brill 27-G.E.-1 trucks equipped with Westinghouse 101-B-2 motors; quadruple equipment; single end control; P. C. & C. Co.'s "Positive" sanders; electric bell circuit; celluloid sanitary hand straps; polished bronze trimmings. One of the cars is illustrated herewith.

Ottawa Car Co's New Manager

In a recent issue of the Electrical News it was announced that Mr. W. K. Jeffrey, who has been acting manager of the Ottawa Car Company for some time, was recently appointed manager. Mr. Jeffrey has only been with the Ottawa

Mr. W. K. Jeffrey

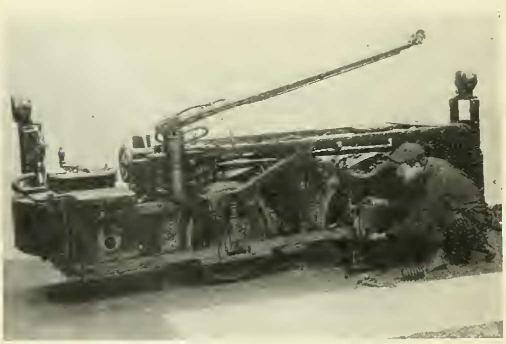
Car Company for eight years, starting in a very minor position, and his rapid promotion indicates at the same time his business ability and his appreciation by his company. Mr. Jeffrey was born in Kinburn, Ont

New Type of Mine Locomotive

The accompanying illustration shows a new type of mine locomotive which has recently been placed on the market by the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Company. The notable features are the open, cast-steel bar frame and the specially designed commutating pole mine motors. This type of locomotive is distinguished for its accessibility, simplicity, durability and strength. It is claimed that it will operate satisfactorily under the worst conditions with minimum attention and maintenance expense. The frame is designed to give maximum strength and to allow ready access to all parts so that the locomotive can be inspected and overhauled, when necessary, in the least possible time. The construction is the same as that used on heavy Baldwin steam freight engines.

The open frame gives much better ventilation to the motors and resistance than that obtained by armor-plate frame construction. The motors, brake rigging, brake shoes and sand boxes are easily accessible. The upper parts of the motors and armature bearing housings can be removed without disturbing the suspension, so that each part of the motor is exposed for inspection. To remove the grid resistors the only work necessary is to take off the locomotive covers and loosen the bolts and terminals that hold the resistor frames in place.

An attractive feature introduced on locomotives with outside frames is the Vauclain removable gib. To remove a journal box with this gib, it is only necessary to drop the binder and take the weight off the journal box. The journal box may then be slipped out from the side. On locomotives with inside frames, the journal box cellars are arranged to be easily dropped out for re-packing. If it is desired to take



New type Westinghouse mine locomotive

out a set of wheels and axle, this may be done without disturbing the motor suspension or connections by simply blocking the motors in place and removing the binders. The wheels may then be dropped.

The motors used in this locomotive have decided advantages over other types, of which their excellent commutation, due to the use of commutating poles, is of first importance because it increases reliability of operation and cuts down the cost of maintenance. With good commutation, the commutator and brushes require very little attention and brush renewals are seldom necessary. The insulation of armature and field coils remains in good condition for a much longer time than on other types because of the absence of copper and carbon dust.

The frames of the motors are made of cast steel and are split diagonally. The axle bearings and suspension nose are on the lower half of the frame, so that the upper half, the armature, and bearing housings can be removed without disturbing the suspension of axle brackets. The armature and axle bearings are of bronze and are oil-and-waste lubricated. The armature coils are form wound and are made moisture-proof by means of an impregnating compound. The field coils are impregnated and protected from vibration by heavy cushion springs placed between them and the motor frame. The armature core is mounted on a spider to which it is keyed, making it possible to remove the shaft without disturbing the windings, and also reinforcing the shaft against bending. Large openings are provided in the spider and through the core to give sufficient ventilation.

Track Paving Costs

A paper was recently read before the Canadian Society of Civil Engineers by Mr. Frank Chappell, town engineer of Oshawa, on the subject of street and railway track paving with asphalt block in a suburban town. Mr. Chappell gave some interesting figures regarding the cost of this work, which we reproduce herewith.

Price of gravel, deposited on work by teams at contract price	$1.00 cu. yd.
Price of cement deposited in shacks	1.52 barrel
Superficial Prices:—	
Excavation and grading	.17 sq. yd.
Concrete base (5")	.53 sq. yd.
Blocklaying and ½" cushion	.22 sq. yd.
Blocks—teamed on to the work (freight Windsor to Oshawa inclusive)	1.57 sq. yd.
Cubic Yard Prices for Work Under Track:—	
Excavation	.50 cu. yd.
Concrete base	4.68 cu. yd.
Curb and gutter	.56 per lin. ft.
Average cost of catch basins	24.00 each
Total cost per lineal foot of 40 ft. road	14.84
Total cost per lineal foot of 35 ft. road	12.98
Total cost per lineal foot of 30 ft. road	11.12

These measurements are taken from face to face of curb.

This table of total costs includes paving the street, laying curb and gutter, paving the track allowance, extra concrete under the ties, the dismantling and relaying of the track, age of the pavement was 14,300 sq. yds., and the total cost together with all catch-basins, etc., required. The total yard-including the foregoing incidentals was $47,750.00.

Electrification of Melbourne Suburban System

Announcement has just been made that a contract for the electrical equipment for the electrification of the suburban railways around Melbourne, Australia, has been awarded to the General Electric Company, Schenectady. The mileage of the system to be electrified is approximately 300 miles. Power will be supplied from a central station in one of Melbourne's suburbs, and will be three-phase, 25 cycles. This will be transmitted at 20,000 volts to 12 sub-stations placed at various points on the system and where it will be converted into direct current at 1500 volts. The General Electric contract includes 400 motor car equipments consisting of four motors each and 800 control equipments, 400 being for trailer cars. Each car will carry four motors rated at 140 h.p. each at 725 volts. The motors will be operated two in series from the 1500 volt feed lines.

Montreal Tramway Problems

The affairs of the Montreal Tramways Company have again been before the public during the last two weeks, and many suggestions for the solution of the tramways problem have been put forward. One is that the city council and the company should get together in order to devise a means of breaking the present deadlock. The council are making inquiries as to whether the company have lived up to their contract with the city. Controller Dupuis is in favor of

plant, in selecting he believes it is the only way of effect-
ing voltage, is co he traffic problem. The Tramways Com-
with time. The
pany ... ng with the city of Westmount for a fast
n selectin
service, and ... arry out the scheme two or three pieces of new track will have to be laid. It is hoped to avoid the present congested lines and to save several minutes by the new route.

Appointed Signal Engineer

Mr. R. F. Morkhill, electrical engineer, has been appointed signalling engineer of the Grand Trunk, with office at Montreal, in succession to Mr. C. A. Dunham, who has resigned. A little more than six years ago he was in charge of the signalling on the Central South Africa Railway after the war, organizing the signalling system on that road. He was then employed in the head sales office at New York of the Union Switch & Signal Company, and was later one of the assistant engineers in the construction of the Pennsylvania's New York terminals. Later Mr. Morkhill joined the Railway Signal Company of Canada, Limited, which was then being organized, as sales manager. Last August he was made assistant general manager of this company.

Report on Tramways Congestion

Mr. John P. Fox, who has been engaged by one of the Montreal papers to inquire into the local tramways situation, has made a preliminary report dealing with the overcrowding, with a view to remedying the congestion which takes place at the rush hours. His report may be summarized by the following suggestions, which he believes, if adopted, will immediately lessen the present over-crowding:

1. Abolition of the cross-seats, which prevent the even distribution of passengers through the whole body of a car. This will not lessen the seating capacity and will relieve the back-platform crowding.

2. Removal of the heavy partitions between the rear platform and the body of the car.

3. Installation of sliding or folding doors at the steps of all cars to protect the dangerous overcrowding of the rear platform. This expedient has been adopted in many United States cities with marked success.

4. Operation of every car available for service; this includes the transforming of the old open cars into a closed type, which can be used to relieve the situation until modern cars can be obtained elsewhere. Single-truck cars are bad, but they should not be scrapped until enough new cars are available to greatly reduce the present overcrowding.

5. Single-truck cars should be operated in pairs, or connected together by an enclosed centre-platform, after the Boston model.

6. The company should make every effort to reduce delays in the actual operation of its car schedule.

7. There is, as yet, no convincing evidence that more streets are needed to make a satisfactory service possible. The cars operated in Montreal during rush-hours do not approach the number operated in other cities.

8. The double-tracking of St. James street and of Notre Dame street is feasible and would greatly relieve the congestion on Craig street, as well as facilitating the handling of rush-hour crowds.

9. A reserve of cars should be stored near the centre of the city for rush-hour needs.

10. A new type of double-truck car is urgently needed here. The latest Montreal cars have only forty seats, while a far lighter type used in Pittsburgh has 67. Double-deck cars, with seating capacities of from 90 to 100 passengers, could be operated without difficulty on most of the important lines here.

Mr. Fox's report was submitted to Messrs. Huntly Drummond, president of the Board of Trade; Chas. Chaput, president of the Citizens' Association; Col. Labelle, president of the Chambre de Commerce; Henry Miles, president of the Montreal Business Men's League; and Mr. Foster, president of the Trades and Labor Council. At a later date Mr. Fox will submit another report dealing with various other points in the tramways situation.

Educating the Public

The Chicago City Railway Company, who have recently inaugurated a number of "nearside" cars, are educating the public in the correct use of these cars by full page advertisements in the local papers. The picture of entrance-exit of the car takes up practically the whole page, leaving only enough space for the following explanations: "The Chicago City Railway Company stands for improving service. The management of this company is directing its efforts towards the best methods of securing maximum convenience and comfort of passengers, increased welfare and efficiency of employees, and reduction of accidents to a minimum. Your co-operation is necessary. The Nearside car is the safe way.

Personal

Mr. H. A. Brazier has been appointed assistant city engineer of London, Ont.

Mr. M. H. Baker, city engineer of St. Thomas, has been appointed city engineer of Prince Albert, Sask.

Mr. W. N. Ashplant has been appointed city engineer of London, Ont.

Mr. D. H. McDougall has been appointed assistant general manager of the Toronto Electric Light Company.

Mr. R. E. T. Pringle has moved his headquarters from Windsor, Ont., to 308-9 Tyrrell Building, 95 King street west, Toronto.

Mr. F. L. Hubbard has been appointed assistant to the general manager of the Toronto Railway Company. Mr. Hubbard is a son of Ald. W. P. Hubbard, of Toronto.

Mr. A. J. Soper has been appointed district sales manager for Ontario for the Northern Electric & Manufacturing Company, with headquarters in Toronto.

Mr. W. H. Tees has resigned as chief electrician of the Canadian Consolidated Rubber Company, Montreal, and is now Assistant Superintendent of the Sayer Electric Company, Montreal.

Mr. Wm. G. Merowitz has severed his connection with the Holtzer-Cabot Electric Company, of Boston, Mass., and is now engaged as a power apparatus sales specialist in the supply sales department of the Northern Electric & Manufacturing Company, Montreal.

Edmonton Telephone Plans

The city of Edmonton will spend in the neighborhood of $1,000,000 on extension work during 1913, the greater part of which will be cable work. It is the intention of this municipal department to build a lot of underground conduit both in South Edmonton and North Edmonton, and there will also be considerable underground cable work and aerial cable work. Very little open wire construction is used except in very sparsely settled districts. Last year this department built two new branch exchanges giving them four exchanges in all at the present time. Mr. W. R. Griffith is superintendent of Edmonton's telephone department.

The plans of the Humber Valley Electric Railway have been approved by the Ontario Railway and Municipal Board. This railway will parallel the old Belt Line from the lake shore to Bloor street.

Illumination

Proper Lamp Voltages

An incandescent lamp consumes its rated wattage, gives its rated candle-power, and lives its rated life only when supplied with current at a voltage equal to the rated voltage of the lamp. If the voltage supplied to the lamp is less than the rated lamp voltage, the candle-power and the wattage consumption are decreased and the life is lengthened. If the circuit voltage supplied is greater than the rated lamp voltage, the candle-power and wattage consumption are increased and the life is shortened.

In any electric supply system the voltage supplied may not be the same at various parts of the system at any one given time, and it may not be the same at one location at different times of the day, or, in other words, the voltage may be said to vary with the distance of transmission and with the time of day. As the voltage varies, the connected lamps will undergo variations of candle-power, wattage consumption, efficiency and rate of destruction (consumption of inherent life). When a lamp is chosen for use on a circuit, it is usually selected because it is known that at some certain voltage the lamp will give a certain candle-power, consume a certain wattage, have a certain efficiency, or give a certain life. If the voltage of the circuit does not stay approximately constant at the predetermined value the above criteria of selection cannot be applied. The best that can be done is to select the lamp with respect to the line voltage and its variations so that the average candle-power values given at all times would be the same as if the lamp were burned continuously at its rated voltage; similarly, the

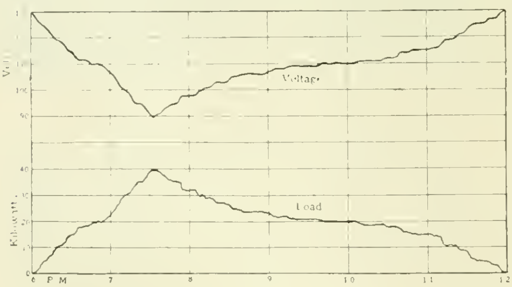


Fig. 1

wattage consumption or the efficiency might be adjusted for correct average values, or the lamp voltage could be so chosen that the life of the lamp would be the same as when burned continuously at rated voltage. Of the above mentioned factors—candle-power, wattage, efficiency and life—the last will be found to vary more with change of voltage than any of the others. Hence, if a lamp is so selected that a proper life is obtained, approximately correct values of the candle-power, wattage and efficiency will also be obtained.

It is but natural to make the assumption that the average voltage of a circuit during lighting hours is the proper voltage rating for the lamps to be used thereon. If a lamp is burned half of the time at a given percentage below its normal rated voltage and half of the time at the same percentage above this normal value, it will be found that its life is decreased. The magnitude of the decrease will depend upon the difference between the burning voltages and the rated voltage. The reason for this is that in a given period of burning at over-voltage, more of the inherent life of the lamp is consumed than is recovered when burning for an equal length of time at a corresponding amount under-

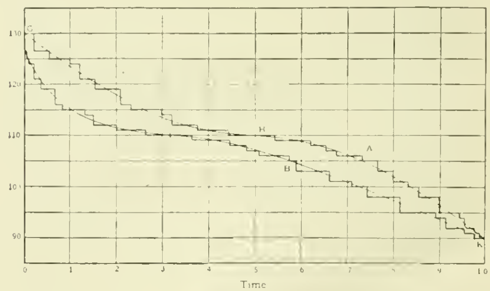


Fig. 2

voltage—the net effect being to obtain a shorter life than when burned continuously at rated voltage.

It is evident, therefore, that if during lighting hours the voltage of a circuit fluctuates above and below an average value, the theoretical proper lamp voltage is slightly higher than this average voltage; and the greater the fluctuations, the greater should be the difference between average voltage and lamp voltage. This theoretically proper lamp voltage might be called the "effective voltage" of the circuit, since it is the voltage which is effective in selecting lamps. Since the effective voltage is determined by the effect of voltage upon lamp life, it will depend upon the class of lamp considered, i.e., will not be the same for Mazda lamps as it is for Carbon, etc.

Mathematical analysis shows that it is only on circuits which have excessive voltage fluctuations (such as heavily loaded combination power and lighting circuits, railway circuits, etc.) that this difference will amount to enough to warrant serious consideration. As a general rule it may be stated that the difference between the scientifically correct lamp voltage and the average line voltage during lighting hours will not amount to even one volt unless the circuit voltage fluctuates more than 6 per cent. above and below this average value.

In general a customer of a central station or an isolated

plant, in selecting lamps to be used on circuits of fluctuating voltage, is concerned only with the variations of voltage with time. The management of the central station, however, in selecting lamps for use on the whole system, is confronted with a more complicated problem, since in this case the variations of line voltage both with time and with distance should be considered.

In cases where very great variations of voltage with distance are encountered, it is not uncommon practice to use different voltages of lamps for different districts. The advisability of such a procedure is more often a question of policy than of theoretical necessity, hence it will be assumed in illustration that only one voltage of lamp is to be used throughout the system and methods will be discussed whereby the proper lamp voltage may be determined.

An accurate theoretical determination of the proper lamp voltage would require that throughout a day voltage readings be taken at intervals of a few minutes on the premises of all the customers of the stations, and that such a proceeding be repeated several times during a year in order to take account of the seasonal variations of load. An investigation of so great a magnitude would manifestly be out of the question, hence approximations may be introduced to shorten the work. The first approximation would doubtless be to lessen the number of locations at which voltage readings are to be taken. Readings at the centre of the load, or so-called "centre of gravity" of each feeder or small district will be sufficient for the feeder, since the low voltage beyond the centre will compensate for the high voltage between the centre and the station.

The data which should be taken for each feeder or district are simultaneous readings of the voltage at the centre and of the total load on the feeder. If the investigation is limited to the taking and averaging of voltage readings only, and no attention is paid to load, erroneous conclusions may be drawn. On the majority of electric supply systems a large part of the voltage fluctuation is due to load variations, the voltage being high during periods of light load and low during periods of peak load. For this reason, the low voltage readings should be given greater weight than the high

TABLE 1.

Line Voltage	No of Readings	Sum of Loads at each voltage	Line Voltage	No. of Readings	Sum of Loads at each voltage
90	1	40	109	7	147
91	1	39	110	9	180
92	2	76	111	6	114
94	1	36	112	5	90
95	4	140	114	2	32
98	4	128	115	6	90
100	2	60	116	2	28
101	3	87	119	5	55
103	3	81	121	3	27
105	3	75	124	2	12
106	5	120	125	4	20
107	2	46	127	3	9
108	3	66	130	2	0
			Total	90	1798

voltage readings. It is evident that a straight arithmetical averaging of all voltage readings would give a final average voltage higher than an average in which the readings were all weighted in proportion to the number of lamps on circuit (total load on feeder, if load is all lighting) at the time of the reading.

The following is given as an example of the correct method of working out the average voltage for a lighting circuit. In order to illustrate clearly the principles involved, a circuit of excessively bad voltage regulation was assumed on which the station voltage is maintained at 130 volts and on which the line drop from the station to the "centre of gravity" of the load is approximately one volt per kilowatt of load. Fig. 1 shows the assumed load and voltage curves. If these readings are tabulated according to voltage, the results would be as shown by Table 1. The first column is the number of readings at which each voltage prevailed on the line. The third column is the sum of the load readings (kilowatts) corresponding to each of the voltages. Fig. 2 shows the tabulated data plotted in curve form. Curve A is plotted directly from the voltage readings alone. The length of each horizontal step shows the comparative length of time (number of readings) during which each particular voltage prevailed on the line, hence we will call this style of graph a "duration curve." The arithmetical average of this curve is 110 volts, and the effective value or proper lamp voltage (for Mazda lamps) is 114.9 volts. The weighted curve, B, is plotted by making the length of each horizontal step proportional to the total kilowatts of load corresponding to each voltage, rather than proportional to the number of readings at each voltage. The effective value, or proper lamp voltage, for this "duration curve" is 111.3 volts. It is thus seen that a considerably different result is obtained when all the voltage readings are properly weighted with respect to the number of lamps on circuit at the time.

If the voltage readings had been obtained from a street-railway circuit on which a constant number of lamps is used, the effective value of Curve A would give the proper lamp voltage directly.

De Luxe Set for the Home

The Tungstolier Company of Canada claim to have been the first fixture manufacturers on this continent to offer a complete set of fixtures for a home. This method of selling fixtures should appeal greatly to the dealer as he is in a position to show the customer just what he can offer and at the same time he can know the absolute cost of the complete outfit. This company are now getting out additional sets of fixtures for residential use under the name of De Luxe set.

Typical Unit of De Luxe Set

A cut of the first set appears in the advertising pages of this issue of the Electrical News. The De Luxe set is one of the most attractive propositions ever sold by the Tungstolier Company. The fixtures are well made and handsomely finished. Another feature embodied in these sets is the method of packing always followed by this company, namely, a complete set in one box.

The Dealer and Contractor

Why Electrical Contractors Fail

Statistics show that during the last twenty years sixty-five per cent. of electrical contracting firms have ended in disaster and the cause of this unfortunate condition should, if possible, be discovered and remedied. It is probable that these contractors failed to appreciate the heavy cost of running their business and in making estimates, omitted to make a proper allowance for overhead expenses. This seems all the more likely in view of figures recently compiled by the Electrical Contractors' Association of Illinois, which show that in the smaller concerns overhead charges may easily amount to well up to 50 per cent. of the business done. Some actual examples were given, as a $10,000 business being found to cost forty per cent. in overhead expenses; a $20,000 business 28 per cent.; a $30,000 business 23 per cent.; a $100,000 business 17 per cent. This evidently is harder on the small contractor, and so it is all the more necessary why he should studiously consider this element in his expenses.

There is also the other important consideration that the large majority of electrical contractors have risen from the ranks of the wiremen, and so lack the business education and experience necessary to compute, accurately, the cost of carrying on their business. As a result the work is carried on in more or less of a haphazard, guess-work way which very soon also shows itself in the methods of the employees with the final results already noted.

Profiting by the experience of others, the more successful contractors have seen the necessity of carrying on their business in a systematic manner, making careful note of all expenses and watching the results of every individual piece of work to see where any little losses may have crept in that were unexpected, or any little profits that may have shown themselves which were worth developing. As an example of the plan followed by one successful contractor whose work is chiefly in private residences and the smaller factories, we reproduce herewith a miniature copy of an estimate sheet which he has gradually evolved through several years of experience of the requirements of his business. It will be noted that in the left-hand column of this sheet what may be called the requirements of knob and tube work are tabulated. On the right-hand side the blank portion increases the usefulness of the sheet by making it available for other classes of work such as conduit, or in factory wiring, where drop lights, glassware or lamps may be included in the specifications; or again, for keeping track of extras. In the lower right-hand corner there is a place for keeping tab on labor, and a space for the all-important overhead expense. A feature of great importance in this estimate form is the double column, as shown, in one of which his estimate of the quantity of material is placed. Against this (after the work is done) he puts in the other column the actual amount of material used. Under the heading of cost there are also two columns, the first dealing with the estimate, the second with the actual. This plan, followed out systematically, will show at a glance how close he has been able to estimate on any work of a certain kind, and if another piece of work which is quite similar to anything he has already done, comes along, he is then in a position to know the actual costs.

Date..........

Name..........

Address..........

Material	Quantity		Cost				
	Esti-mated	Actu	Esti-mated	Actual		Esti-mated	Actual
Inspection							
Cartage							
Tape							
Wire							
14 Wire							
Alphaduct							
Knobs							
3 in. Tubes							
5 in.							
Snap Switches S. P.							
3 Way							
Flush Switches							
3 Way							
2 Pt.							
Receptacles					Total Material		
Knife Switches							
Cutouts					Labor		
Asbestos							
Standpipe							
					Overhead Expenses		
Bells							
Total					Grand Total		

These forms, of course, are filed for reference, each being attached to the schedule or specification of the job or

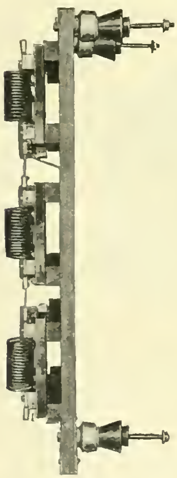
contract to which it refers, and the fact, as stated above, that this particular contractor has been successful where others in the same class have failed, is the best proof that a system of this kind is not only desirable, but is, other things being equal, essential, if the work of the electrical contractor is to be carried on on a fair and profitable basis.

The right price to charge for a job of electrical work is one that will leave a profit over and above all cost, including stock, labor, depreciation, advertising, spoilage, insurance, power, light, fuel, rent, taxes and the thousand and one other items of expense the contractor is called upon to pay. Guessing methods, second sight, mind reading, telepathy and similar methods will not give that cost. It requires a well-planned and operated cost system to do it; and the quicker a contractor installs that, the better he will succeed.

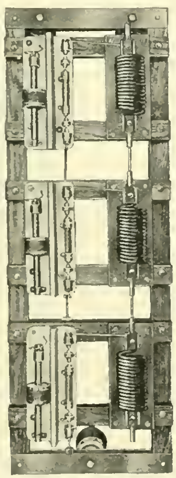
Panel Board Lightning Arresters

A great many railway, lighting, mine and industrial properties have certain "spots" where lightning conditions are particularly severe, and where it is difficult to secure thoroughly efficient and reliable lightning protection. In other cases, particularly central station and mining properties, there is certain electrical apparatus that needs what might be termed one hundred per cent. protection. For mining service, such apparatus might supply power to fans and pumps; or for central station and electric railway service, very important pieces of generating or transforming apparatus, on which much depends.

For the protection of these important installations, the Electric Service Supplies Company has placed on the market a line of panel board lightning arresters, for both d.c. and a.c. service. Illustrations of typical boards for both



Side view 2500 v. a.c. panel board



2500 volt a.c. panel board

d.c. and a.c. service are shown herewith. These boards are built on the theory that no matter how efficient a lightning arrester may be, it will never carry off every bit of a lightning discharge from a given line. Some small portion will always find its way past an arrester, through any choke coil in back of the arrester and into the apparatus to be protected. With an efficient lightning arrester and a suitably designed choke coil, this leakage will be small, usually not enough to damage the apparatus. With very heavy induced strokes, and under certain other conditions, the leakage may become heavy enough to damage the apparatus. These panel board arresters are designed to effectually take care of this leakage by interposing additional choke coils between the line and the apparatus to be protected, and of connecting lightning arrester units ahead of these coils. Any leakage passing the first arrester unit, for instance, in a triple board, must pass through three choke coils and by two additional arrester units before it can get into the apparatus.

With but a single choke coil and a single arrester unit, and assuming that 9/10 of the discharge goes to ground through the arrester, it is seen that 1/10 will be left to enter the apparatus. If an additional choke coil and a second arrester unit be placed back of the first set, and assuming that the second unit takes 9/10 of the leakage 1/10 to ground, only 1/100 of the original charge remains to flow into the arrester unit, but 1/1000 of the original charge will be left to enter the apparatus to be protected. In other words, by apparatus. Similarly with a third choke coil and a third the addition of extra arrester units and extra choke coils, the protection to apparatus has been increased ten times by a double panel board, a hundred times by a triple panel board, and a thousand times by a quadruple board.

The boards are regularly furnished in station type, mounted on heavy impregnated oak framework and are furnished complete with insulators for attaching to any suitable supporting means. The arrester units are furnished with highly polished and lacquered metal work. Choke coils are of copper, black enamelled and baked. They are designed especially for the protection of apparatus up to 6600 volts a.c., up to 2500 volts d.c. railway, and up to 6000 volts d.c. or a.c. arc circuits, and are furnished in any ampere capacity for voltages within this range.

Use Your Show Windows

If you are located on the principal street you are paying an increased rent owing to the fact that you have an attractive display place for showing goods. Why not get the greatest possible advertising value out of this place?

If you contract for newspaper space you would not think of leaving it blank, so why leave your show windows in a condition where they do you no good when they can do more for you, possibly, than any other form of advertising, but a window that is allowed to become dirty, and never changed, is a detriment to your business.

If you intend to use your show windows, they should be decorated systematically and carefully. Windows should be kept absolutely clean, should be filled with fresh goods, and should be kept carefully dusted.

The display should be changed at least every two weeks, and placards used showing the price and uses of the articles shown. At different seasons the windows should be devoted to the special article that is in use at the particular time.

Moving displays can also be used to great advantage and at a comparatively small expense. A moving display in a window always attracts a crowd, and if properly placed and placarded should result in greatly increasing your sales. You will also find that manufacturers will be glad to supply you with window displays, and the necessary cards and advertising matter to go with it. An example of this is shown by the displays furnished by the lamp manufacturers, which have attracted attention all over the country. Supplies of this kind can be well handled by using them at a time when the manufacturer in question is using general publicity in the magazine. This will result in your securing the benefit of his general advertising, as well as your own show windows.

Think it over and see if you have given this chance of good advertising the proper consideration, and if not take

it up the coming season and make your windows attractive and profitable to your business.—National Electric Contractor.

Table of Carrying Capacity of Wires

The following table, showing the allowable carrying capacity of copper wires and cables of ninety-eight per cent. conductivity, according to the standard adopted by the American Institute of Electrical Engineers, must be followed in placing interior conductors.

For insulated aluminium wires the safe carrying capacity is eighty-four per cent. of that given in the following tables for copper wire with the same kind of insulation.

B. & S.	Rubber Insulation Amperes	Other Insulations Amperes	Circular Mils
18	3	5	1,624
16	6	8	2,583
14	12	16	4,107
12	17	23	6,530
10	24	32	10,380
8	33	46	16,510
6	46	65	26,250
5	54	77	33,100
4	65	92	41,740
3	76	110	52,630
2	90	131	66,370
1	107	156	83,690
0	127	185	105,500
00	150	220	133,100
000	177	262	167,800
0000	210	312	211,600
	200	300	200,000
	270	400	300,000
	330	500	400,000
	390	590	500,000
	450	680	600,000
	500	760	700,000
	550	840	800,000
	600	920	900,000
	650	1,000	1,000,000
	690	1,080	1,100,000
	730	1,150	1,200,000
	770	1,220	1,300,000
	810	1,290	1,400,000
	850	1,360	1,500,000
	890	1,430	1,600,000
	930	1,490	1,700,000
	970	1,550	1,800,000
	1,010	1,610	1,900,000
	1,050	1,670	2,000,000

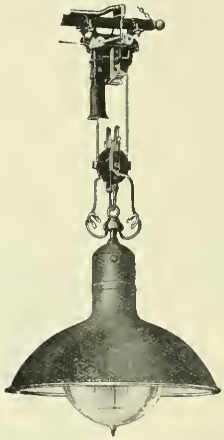
The lower limit is specified for rubber-covered wires to prevent gradual deterioration of the high insulations by the heat of the wires, but not from fear of igniting the insulation. The question of drop is not taken into consideration in the above tables.

The Simplex Wiring Computer

Electrical engineers and wiremen will be interested in the wiring computer which the Simplex Wire & Cable Company, of Boston, are distributing. The computer is mounted on stiff thick celluloid of a convenient pocket size and consists of a circular slide rule particularly adapted for wiring calculations. By a single setting of the computer the following results may be obtained:—the size B. & S. gauge of a wire is readily determined by setting the disc to correspond to a given distance of distribution for a desired voltage drop and the current which the wire is to carry; or given the size B. & S. gauge, the current to be carried, and the distance of transmission, the resulting voltage drop may be read directly upon the computer. In like manner, the current may be found at one setting for a desired voltage drop with a definite sized wire and distance of transmission. Finally the distance to correspond to specific conditions of voltage drop, current and size of wire may be found by a single setting of the disc. The setting of the disc is very simple and directions for attaining these four different results are given explicitly at the foot of the card and much laborious figuring is avoided by its use. On the reverse side of the pocket card are handy tables of wiring data and table of decimal equivalents of fractions of an inch.

Safety Cut-out Hanger

The Thompson Electric Company, Cleveland, have issued a folder giving ten reasons why the Thompson Automatic Safety Cut-out Hanger should be made a part of every lighting system. This cut-out device is one by which any lighting unit in a multiple circuit may be automatically cut out and lowered to the ground for cleaning, trimming or renew-



ing. It is made in two sizes, one for enclosed and flaming arc lamps, the other for large tungsten units and clusters. It is particularly adapted for use in railway shops and sheds, mills, factories and industrial plants of all kinds. The accompanying illustration represents the small multiple type for use with tungsten units.

Engineering Works of Canada

The Engineering Works of Canada, Montreal, have issued a catalogue describing their two and three phase induction motors. The following types are described: type N, an open type in capacity from ½ to 200 h.p., built with squirrel cage or slip-ring rotor; type NA, having a rotor with two special windings, and type NE, a special design of enclosed motor requiring only a slight increase in size over the open type. The type NA was designed for use where constant speed is required with a high starting torque and perhaps frequent starting of the motor. With the ordinary slip-ring type rotor a resistance has to be kept almost constantly in circuit involving a considerable loss of energy. This disadvantage has been overcome by providing the rotor with two windings, one of copper and one of iron. The motor is started on the iron winding which is of high resistance and after the motor reaches a pre-determined speed the copper winding is automatically cut into the circuit, the iron winding being cut out at the same instant. An im-

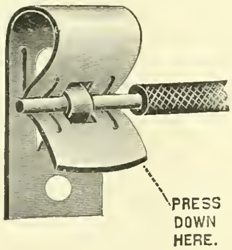
portant feature in the design of the NE type is the provision for two different circulations of air completely separated and independent from each other. The capacity of this enclosed motor is only 15 per cent. less than that of the same size open type. This company also have patented a very simple mechanism by means of which single phase induction motors can be started under load exactly as an ordinary polyphase induction motor without too high a starting current. This company make installations of complete rolling mill, hoist and mining machinery.

Lightning Arresters

Tht Electric Service Supplies Company, Philadelphia, Chicago and New York, have issued their 1913 edition of catalogue on Garton-Daniels lightning arresters and other lightning protective apparatus which is in reality a short treatise on Lightning Arresters. In this booklet is given much information relative to lightning phenomena, installation of lightning arresters, grounding, distribution, inspection and other allied subjects. Its catalog pages illustrate and describe the complete line of Garton-Daniels lightning arresters, a new line of panel board lightning arresters catalogued for the first time by this company, high voltage and low voltage choke coils and disconnecting switches, grounding apparatus, etc. The last eight pages are given over to installation diagrams, through which it is possible at a glance to not only learn the proper method for installing lightning arresters on any circuit, either d.c., a.c. or arc, but also to select exactly the type of arrester which is best suited for the protection of any class of circuit.

Spring Binding Post

The accompanying sketch illustrates the Fahnestock spring binding post manufactured by the Fahnestock Electric Company, of 129 Patchen avenue, Brooklyn, N.Y. This binding post has much to recommend it in that contacts are quickly made, the electrical contact is good, and suspicion of



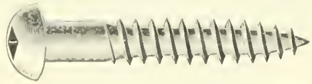
bad contact can be very easily tested. This type of binding post is being installed very largely on batteries of various kinds but is applicable to practically every kind of electric service.

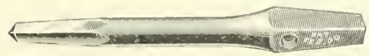
Imperial Wire & Cable Co.

The Imperial Wire & Cable Company, Limited, Montreal, are opening an office at Room 611 C. P. R. building, Toronto. Mr. A. J. Soper, formerly connected with the sales department in Montreal, has been appointed district sales manager for Ontario. The same company are also opening an office in Winnipeg, and have taken temporary quarters at 158 Portage avenue east, and later will move into the Electric Railway Chambers as soon as they are completed. Mr. W. F. Uhl, formerly in the sales department of the Northern Electric and Manufacturing Company, Winnipeg, has been appointed district sales manager for Manitoba, Saskatchewan, and Ontario, as far east as Fort William and Port Arthur.

A New Wood Screw

We illustrate herewith a new make of wood screw which we believe will fit the needs of the electrical contractor and save him much valuable time in making installations in difficult places, at the same time enabling him to perform this work efficiently. The screw has a square hole in the head into which a specially designed screw driver fits. In cramped places or for an insertion which is almost out of reach





of the workman, this screw may be placed on the driver, reached out at arm's length and driven with one hand. Various types of drive are available and all kinds of wood screws covering the different phases of electrical installation work. This screw and driver is manufactured by the P. L. Robertson Manufacturing Company, of Milton, Ont., and attention is drawn to his advertisement appearing on another page of this issue.

Jovian Rejuvenations

The first rejuvenation of the Saskatoon Jovian Order was held at the King George Hotel on Saturday evening, February 22, when Mr. Edward Hanson, City Electrical Engineer of Saskatoon, was elected statesman of the local order. Twenty-eight members were initiated at this rejuvenation, which is claimed to be a record, taking into consideration the size of the city. Among those taking part in the rejuvenation were Mr. C. H. Abbott, Mr. J. G. Monahan, Mr. E. H. Smith, Mr. Raymond Wright, of Prince Albert, and Mr. W. H. Reynolds, who acted as chairman. It was stated at this banquet that the total number of members of the Jovian order in Canada is now approximately 9,000.

Notice has been sent out by Mr. E. B. Pike, Statesman for Ontario, of a rejuvenation to take place on Friday, April 4, 1913, in the large ball room and assembly hall of the Temple Building, Toronto. Mr. W. W. Lovell, chairman of the degree team committee, is already holding rehearsals. The letter states that application blanks for new members can be secured from Mr. S. C. Dewitt, chairman of the membership committee, 90 Sherbourne street, or from Mr. Pike at 220 King street west, and the personal co-operation and assistance of the members is requested in bringing in new members.

Regarding the Jovian luncheons which have been held weekly at the Prince George Hotel, it has been decided not to continue them under the present circumstances, due to fact that there was no privacy, and the weekly talks could not be indulged in. It is now proposed to charter a private dining room in the same hotel to accommodate about forty-five persons. It will be necessary, however, to guarantee this number of guests and it has been suggested that a small assessment be made on the members which shall form a sinking fund to take care of any possible deficit. The assessment suggested is only 25c a month, and the co-operation of all good Jovians is requested in sending in their remittances to Mr. J. Ward, treasurer, care Northern Electric & Manufacturing Company, Toronto.

Electric Vehicles at the Motor Show

As far as electrically driven automobiles are concerned, the recent motor show in Toronto could scarcely be considered a success. Only two firms of electric vehicle manufacturers exhibited, and there was a noticeable absence of electric trucks, a vehicle which is coming so prominently into use in the last year or two. The exhibit of the Peck Electric was especially worthy of notice. This car represents the latest refinements in automobile construction, and was the centre of admiration throughout the exhibition.

Exclusive Canadian Agents

The Northern Electric & Manufacturing Company, Limited, Montreal, have been appointed exclusive selling agents in Canada for the American Electric Heater Company of Detroit, who claim to be the largest exclusive manufacturers of electrical household appliances in America. It is the intention of the Northern Electric company to carry large and comprehensive stocks of this material at each of their distributing houses. This company have also been appointed exclusive agents for the Triangle Lektrik Sales Company of Detroit, manufacturers of the Triangle Lektrik Iron.

New Toronto Address

R. E. T. Pringle, manufacturers' agent, announces his new office address, Room 308-309 Tyrell Building, 95 King street east, Toronto. Former office, 616 Continental Life Building, has been moved to the above address, as is also the Windsor office. While Mr. Pringle will make his head office at above Toronto address, Mr. A. Ross Oborne will continue, as previously, to have charge of all Ontario business.

Lecture on Lamps

Mr. E. W. Sayer, of the Sayer Electric Company, Montreal, lectured on the subject of electric lighting, at the Nomad's Club. Mr. Sayer spoke of the various lamps on the market and their merits, and also gave detailed information concerning various forms of public lighting. People in general were, he said, of the opinion that by using 16 c.p. carbon lamps they were practising economy, whereas if they used 40 watt tungsten lamps they would not only be consuming less current, but getting 100 per cent. better light. Factories and stores were realizing this fact and today were using the tungsten lamp entirely.

Tungsten Sign Lamps

The Canadian Tungsten Lamp Company have recently installed a department for the manufacture of tungsten sign lamps of 5-watt capacity, 12 volts. They report that orders received to date have justified them in placing these lamps on the market, and that they are assured of the greater adaptability and saving properties of this type of lamp as compared with the old carbon. These lamps can be run with from 50 to 75 per cent. less energy than carbon lamps and at the same time give a much whiter light, which is claimed to make a sign of any description more attractive.

Miscellaneous

The retirement of Mr. E. O. Sessions as a member of the firm of Woodmansee, Davidson & Sessions, consulting engineers, Chicago, is announced. Mr. Sessions is a Fellow of the American Society of Electrical Engineers, a member of the American Society of Mechanical Engineers, associate member of the American Society of Civil Engineers, and a member of the Illuminating Engineering Society. His plans for the future have not yet been made public, but will be announced at an early date.

The Siemens Company of Canada were recently awarded a contract for two 1900 h.p. peak-load electric hoisting machines for the Dominion Coal Company, N.S. The Siemens Company have already supplied the Coal Company with other large electric hoisting engines which have given satisfaction, the total of electrical machinery so supplied aggregating some 10,000 horse power.

The Imperial Wire & Cable Company, Montreal, have recently secured orders from the city of Edmonton, and the Alberta and Manitoba Governments. These are for telephone wire, bare copper wire, rubber covered wire, etc.

The International Brotherhood of Electrical Workers, Montreal, are organizing with a view to increasing their rate of wages. The object is to get 35c an hour instead of the 33c an hour now paid.

Trade Publications

Pneumatic Tools—Issued by the Chicago Tool Company. Bulletin No. 126 on Compression Riveters and bulletin No. 129 on Hose, Hose Couplings, and Hose Clamp Tools.

P. & S. Bulletin—No. 760 issued by the Pass & Seymour, Inc., Solvay, N.Y., describing a large number of electric sign installations in which P. & S. receptacles have been used.

Cling-Surface Treatment for Ropes—is the title of a bulletin just published by the Cling-Surface Company, Buffalo, N.Y. This bulletin shows a number of noteworthy treated rope drives; gives technical data, and carefully describes them all.

New Style Panel Board—Descriptive hanger being distributed by the Crouse-Hinds Company of Canada, Limited, descriptive of their type H panel board which is made in 224 standard forms. A distinguishing feature of this board is the 10 ampere, double pole indicating snap switches designed exclusively for panel board branch circuits. This is claimed to be the safest and best panel to install where switches are to be operated by persons not familiar with electrical devices. The panels are furnished with main lugs, main fuse terminals, fuseless main switch or fused main switch. Type H panels can be mounted in any of fifteen types of steel and wood cabinets.

Weights—of Standard Panel Boards, Slate Frames, Door Linings, Boxes and Trimmings.—A booklet issued by the Crouse-Hinds Company of Canada, giving the weights for panel boards, slate frames, door linings, etc., illustrated in Bulletin No. 1, dated October 1, 1910. The information contained in this booklet should be especially valuable in determining shipping costs.

Eleven Words Per Second

A demonstration of the Pollak-Virag system of rapid telegraphy, with which, it is declared, 40,000 words can be dispatched per hour, was given by Antoine Pollak, the inventor, at New York, January 31. By means of a beam of light controlled by motions at right angles, the receiving machine produces written characters on sensitized paper. Owing to the rapid succession of impulses involved, the system is limited in its use over very long inductive iron-wire lines, although entirely feasible within present telephonic ranges using copper circuits. It is reported that during a recent demonstration in France messages were sent 900 miles with this system.

Business is not done by lying awake at night but by keeping awake during the day.

Current News and Notes

Amherst, N.S.

The Canada Electric Company, Limited, of Amherst, N.S., announce that they have discarded their d.c. generators and now have for sale two 75 kw. and two 55 kw. units in good condition.

Berlin, Ont.

Additions to the electrical service equipment are calculated to cost between $40,000 and $50,000 for the year 1913.

Berwick, N.S.

An electric lighting plant calculated to cost $15,000 is contemplated.

Bradford, Ont.

By a vote of 99 to 7 Bradford passed an enabling by-law requesting the Ontario Hydro-electric Power Commission to make a report on the cost and supply of Niagara power.

Brandon, Man.

A contract has been signed between the city and the Brandon Electric Light Company for the supply of power to the new street railway system. The rate is 2c per kw.h.

Calgary, Alta.

The annual statement of the Calgary Power Company shows gross earnings of $191,846, and net earnings of $151,-707.

The Elbow River Suburban Railway Company are making application for a charter. It is said to be the intention to construct an electric line from Calgary along the Elbow River to Canyon Creek.

The price of electric light in Calgary in 1906 was 14c per kw.h. and 15 per cent. discount. After five years of successful municipal operation this rate has been reduced to 7½c per kw.h. with 10 per cent. discount.

Collingwood, Ont.

The rural telephone system operating in Medonte township which at the present time has approximately 300 subscribers, is reported to cost only $8.15 per annum per telephone. This includes interest on debentures, switching charges and upkeep.

Dauphin, Man.

For some months it has been apparent to the Fire and Light Committee that the continual increase of the lighting load in town was putting so great a strain on the present plant that it would be necessary to install new equipment. It is now recommended that an extra boiler, generator and condenser be installed at once. The committee also recommend that 40 ornamental 5-light standards be placed on Main street to be equipped with 50-candle power tungsten lamps, the standards to be 100 feet apart on each side of the road.

Duncans, B.C.

Tenders have been called by DuCane, Dutcher & Company for water turbines, generators, exciters, transformers and switching equipment.

Dundas, Ont.

The Water, Light & Power Commission contemplate the purchase of a synchronous motor.

Edmonton, Alta.

The Alberta legislature will appropriate the sum of $2,-000,000 for telephone extensions during 1913. The plans of W. H. Harmer, Deputy Minister of Telephones, indicate that $900,000 will be required on rural lines, $700,000 for exchanges and $400,000 for long distance lines. The government report shows that there were in operation at the close of the year 6,689 miles of toll lines and 9,671 miles of rural lines connecting 7,120 rural subscribers and giving service to 14,696 exchange subscribers

A by-law passed on February 24th to expend $1,543,220 on street railway extensions.

A by-law passed February 24th authorizing extensions to the electric lighting system, costing $453,000.

A by-law passed February 24th authorizing extensions to the municipal telephone system, costing $848,260.

A by-law passed February 24th to provide additional power house equipment to the extent of $185,000.

According to the amalgamation agreement between Strathcona and Edmonton, tracks were to be laid on 6th avenue south, on Main street to 7th street west, and north to 8th street and University avenue, along to White street, by December 31st, 1913. The city commissioners recently advised against the laying of these tracks on account of the absence of pavements on these streets and for other reasons, but it has since been decided that the agreement with Strathcona must be carried out to the letter.

Elmira, Ont.

Arrangements have been completed between the town and the Elmira Milling Company by which the Elmira electric distribution plant will be taken over by the town at a value of $3,000 and operated as a municipal enterprise. It is understood that power will be taken from the Hydro-electric Commission.

Fredericton, N.B.

It is reported that the Fredericton Street Railway Company will construct a railway to connect Fredericton with St. Marys, Gibson and Marysville, about 5 miles.

Galt, Ont.

The Bell Telephone Company recently acquired a property on Ainslie street, with a frontage of 50 ft. and a depth of 240 ft. It is understood an exchange will eventually be built on this site.

Hamilton, Ont.

The Holman Electric Sign Company has been taken over by Hamilton men and a new charter applied for. The new directors are Robt. Junor, president and general manager, F. W. Hulme, vice-president and sales manager, and J. C. Stewart, secretary-treasurer.

The meter contract for the 1913 supply has been finally awarded as follows: Canadian General Electric Company, single phase, two-wire meters, 1200-10 amp., 150-25 amp., 40-50 amp., and 10-75 amp. Chamberlain & Hookham Meter Company, single phase, two-wire meters, 2000-5 amp., 200-18 amp., and 5-100 amp.; also 220 volt, 3-phase unbalanced power meters, 150-5 amp., 50-10 amp., 20-25 amp., 10-50 amp. and 10-100 amp.; and 550 volt, 3-phase unbalanced power meters, 50-5 amp., 50-10 amp., 25-25 amp., 10-50 amp., and 10-100 amp. The Canadian Westinghouse Company, 110 and 220 volt, three-wire, single phase meters, 200-10 amp., 100-25 amp., 20-50 amp., and 10-100 amp. Contract for all sizes of transformers was awarded to the Canadian Westinghouse Co.

Contract has been awarded to the Canadian Westinghouse Company for equipment for the Hughson street transformer station.

It is expected that the cost of extensions for the current year to the hydro-electric system will exceed $100,000.

Kamloops, B.C.

A flour milling company who are contemplating the erec-

tion of a plant in the vicinity of Kamloops have asked rates on the immediate supply of 75 h.p., this amount to be increased to 500 h.p. It is said a 1½c per kw. hour rate will be offered this company as an inducement.

Knowlton, Que.

A fire alarm will be purchased and installed throughout the town.

London, Ont.

General manager Glaubitz is reported to advocate the pumping of water into the reservoir at Springbank during off peak hours, this water to be used for developing power to help carry the peak load. It is said that 500 h.p. for two hours could be obtained in this way.

Plans are in progress for a hydro-electric line from London to Dorchester.

Electrical extensions to the amount of about $125,000 will be made during the year which will include the following equipment: new work shops; new sub-station equipment including power transformers, lighting regulators and synchronous motor; power generation plant at Springbank; sub-station No. 4 with equipment; line transformers; light and power meters, etc.

At the annual convention of the Associated Board of Trade of the province of Ontario held here on February 27th and 28th, an important resolution was passed asking that the Hydro-electric Commission be given power to undertake a system of electric railways throughout the province.

Shareholders of the Woodstock, Thames Valley and Ingersoll electric railway have moved for the appointment of a receiver for the road on the ground that it is not paying expenses.

Montreal, Que.

Tenders are being called for supplies for underground conduit system from Guy street along St. Catherine to Papineau avenue.

The Montreal Tramways Company have taken out an inscription in appeal against a judgment of Mr. Justice Charbonneau calling upon the company to produce a document in the case of Vipond vs Lovett, which is an action concerning the promotion of two power companies, the control of which passed into the Tramways and Canada Light & Power Companies.

At a meeting of the Montreal Electrical Society, Mr. L. R. McDonald, of X-Rays, Limited, read a paper on "X-Rays in Theory and Practice." After tracing the history of electricity, he discussed the production and effects of the rays, alluding to their penetrative powers. Mr. J. P. Thornton showed a number of slides illustrating the working of the rays, particularly in surgical cases.

The Northern Electric and Manufacturing Company, Limited, Montreal, have issued a calendar, with special features. The upper portion represents the Northern hemisphere, above which is suspended 110 volt 25 watt tungsten lamp (with the words "Northern Light" in the centre), diffusing light over this part of the calendar. Beneath the dates are descriptions of Northern light lamps, together with the firm name and address. The calendar is of very neat design, and well adapted to its purpose.

Mr. Arthur Surveyer, of Surveyer & Frigon, consulting engineers, Montreal, has been offered by the government a position on the Waterways Commission. The government are anxious that both he and Prof. C. H. MacLeod, of McGill, and secretary of the Canadian Society of Civil Engineers, should devote their whole time to the Commission, but these gentlemen, we understand, do not see their way to give up their present positions. They are, however, willing to devote a portion of their time to the Waterways Commission, and the government have this question now under consideration. Prof. MacLeod, Mr. Arthur Surveyer and Mr. W. I. Gear, were members of the old Waterways Commission, but Mr. Gear resigned on the change of government.

Yet another hydro-electric scheme is proposed for Montreal. As yet the promoters will not give out details, except to say that the financing is being arranged and that a company with a capital of about four million dollars is being formed. Sometime ago Heron Island, near Lachine Rapids, was purchased by Mr. J. J. Westgate, president of the Hudson Bay Knitting Company, Messrs. Holland and Hingston being associated with him in the deal. The island contains 180 arpents, and is admirably situated. The intention is to build a power plant and to supply current to Montreal.

Mr. Evariste Champagne has entered an action against the Montreal Public Service Corporation for $194,418. Mr. Champagne was the organizer of the Saraguay Electric & Water Company, whose territory was afterwards enlarged. In 1909 he was made manager. The Public Service Corporation afterwards bought the undertaking, and he asserts that the changing of the name and control has affected his engagement, and he asks to be paid the sum claimed for the loss of privileges and position.

The city of Winnipeg has awarded a contract to the Canadian British Insulated Company, Montreal, for a supply of extra high tension cable.

Moose Jaw, Sask.

Tenders are called till March 26th for one fuel economizer with 7,000 sq. ft. heating surface, and one induced draft plant to handle 120,000 cu. ft. of gases per minute.

North Battleford, Sask.

At the present time the electrical department are busy installing a lot of new machinery in the power house. The work is in charge of Mr. M. D. Cadwell, electrical superintendent.

Oak Bay, B.C.

It is reported that the Council will prepare cost estimates on lighting by cluster lights the whole length of Oak Bay avenue within the municipal limits.

Ottawa, Ont.

By a recent act of the Dominion Parliament, letter carriers in the service of the post office department shall be conveyed on every electric railway in Canada on such terms and conditions and under such regulations as are made by the Postmaster General.

The city council electrical department have planned equipment and extensions to station, for lighting purposes, to cost $22,000.

The Ottawa Electric Railway Company contemplate the erection of a sub-station at a total cost of $75,000.

The Ottawa Electric Railway Company contemplate the double tracking of 1½ miles on Creighton street, from St. Patrick to Sussex street, with 75 lb. rails.

Tenders were called to March 10th for meters, transformers, incandescent lamps, arc lamp globes, carbons and sundry supplies.

Tenders will be called by the Morrisburg & Ottawa Electric Railway, Canada Life Building, Ottawa, for requirements for 15 miles of track.

The City of Ottawa Electrical Department contemplate the purchase of ornamental standards and globes for a white way system recently adopted by the Board of Control.

The Canadian Minister of Railways has decided to establish wireless telegraphy between Le Pas and the Hudson Bay terminal when the harbor work is started. This will allow the department at Ottawa to keep in close touch with

the progress of the work. Extensive preparations are being made to send north an expedition with dredges and equipment to start work on the harbor at the earliest possible date. The government will likely do most of the work itself, as it is not practicable to call for tenders for work as far away as the Bay.

The Railway Commission have made an order requiring the C. P. R. to accept and transmit trans-Atlantic messages for the Marconi Company over the C. P. R. land lines. Bad weather in the east has interfered with the service between Montreal and Glace Bay, and the Marconi Company wanted an alternative route in case of interruption on the G. N. W. lines.

Port Arthur, Ont.

Tenders will be received up to March 31 for the supply of the following railway material: Tender A.—8 tons No. 2/0 round trolley wire; 6¾ tons No. 4/0 flexible feeder wire, D. B. W. P. Tender B.—24,200 ft. 80 lb. 5-in. T rails; 50,000 ft. 60 lb. 5-in.. T rails; 76,500 spikes, 5½ x 9/16; 840 pair angle bars, 80 lb. rail, four hole; 1700 pair angle bars, 60 lb. rail, four hole; 6800 bolts 3¾ x ¾, hex. nuts; 3,360 bolts 4⅜ x ⅞ hex. nuts. Tender C.—Steel intersections, frogs, switches, etc.

Portage la Prairie, Man.

It is said that the radial line connecting Portage la Prairie with Winnipeg, will be commenced this summer and will be completed within two years.

Rapid City, Man.

It is reported there are three small water falls, one within the town limits and the other two just outside the town at which approximately 500 h.p. can be developed in each case under a 15-foot head.

Regina, Sask.

As a result of the difficulty experienced in getting industries to locate in Regina the city commissioners have recommended that the city undertake to supply power up to a limit of 1,000 h.p. at a rate of 1.1c per kw.h., which is equivalent to a rate of $30.11 per h.p. for 365 days of 10 hours each. A by-law was submitted on February 25th, asking authority to spend the necessary money.

Tenders are received till March 29th for weatherproof copper wire, cedar poles, cross arms, top-pins, insulators, pole-line hardware, pole-type transformers, meters, metal flame arc lamps and station equipment, series cut-out mast arms for arc lights, underground material and fire alarm boxes and gongs.

Saskatoon, Sask.

The meter supply for 1913 requirements was distributed as follows: 1200-5 amp. to Canadian Westinghouse; 200-10 amp. and 100-20 amp. to Feilman & Jardine, Winnipeg; 100-40 amp. to Chapman & Walker; 40-80 amp. to Chamberlain & Hookham, and 20-100 amp. to Ferranti. The Canadian General Electric get the contract for insulators, lamps, globes, fuse plugs, etc. The Western Electric supply the transformers.

Tenders will be received up to April 15th for 1 motor pumping engine of 500 gallons capacity, 1 motor pumping engine of 1,000 gallons capacity. Tenderers to quote on their own specifications.

A by-law authorizing the operation of Sunday cars in Saskatoon carried by a large majority. Other by-laws including street railway and electric light extensions carried to the amount of $782,000.

Souris, Man.

The Manitoba Government Telephone Department have just completed the installation of a central energy telephone system replacing the old magneto system originally in force.

St. John, N.B.

An offer has been submitted for the purchase of the St. John electric railway system. It is said the equivalent of $150 a share or a sum of $1,200,000 was offered for the common stock. With the exception of the president, Mr. Jas. Ross, of Montreal, all the directors of the company reside in St. John.

The profits of the St. John Railway Company for the year 1912 after providing for interest and all charges, amounted to $10,158, as profit and loss account now stands at $132,091. This road is bonded to the extent of $1,160,000 with capital stock $800,000.

St. Thomas, Ont.

City Engineer Baker will prepare estimates of the cost of a renewal of the road bed and track of the street railway system on Talbot street.

Swift Current, Sask.

Tenders will be received till March 31st for 1 200 kw. and 1 400 kw. a.c. generators, direct connected to high speed vertical engines or horizontal turbines.

Sydney, N.S.

The profits of the Cape Breton Electric Company for 1912 are said to show a considerable increase over the previous year. It is estimated that $200,000 will be expended on extensions during 1913.

Toronto, Ont.

The Board of Control has decided in favor of the city taking over the franchise of the Humber Valley Electric Railway Company. A by-law will be submitted to the people asking authority to spend the necessary money to build this road.

Application is being made to the Ontario legislature for an Act amalgamating the North Lanark Railway Company with the Ottawa and St. Lawrence Electric Railway Company under the name of the Ottawa and St. Lawrence Electric Railway Company, and increasing the capital stock from $1,000,000 to $5,000,000.

A charter has been granted the Forest Hill Electric Railway Company to build five miles of line in the northwestern part of the city of Toronto. The condition is attached that $50,000 must be spent within the year and the city has the right to take over the line at the end of five years.

A deputation of representatives of the municipalities interested in building a Toronto to Port Perry electric railway line recently waited on the Ontario government asking that the Hydro-electric Power Commission construct and operate this line. Premier Whitney and Hon. Adam Beck both expressed themselves as being in sympathy with the scheme but pointed out that a precedent of this kind would probably mean a tremendous demand from other parts of the province. The government will take the matter into its serious consideration.

Valois, Que.

Tenders will be called after April 1st for the installation of waterworks, electric light station and sewerage system.

Vancouver, B. C.

At the request of the Institute members in Vancouver and vicinity, the Board of Directors has authorized the holding of the annual Pacific Coast Convention of the A. I. E. E at Vancouver, B.C., on September 9, 10 and 11, 1913. The Vancouver Section has been working for some time in preparation for this convention, and has already arranged for a number of papers, and plans are maturing for interesting trips to some of the large hydro-electric installations in the vicinity of Vancouver. Arrangements are being made for special rates over all railroads, and as this will afford to the engineering fraternity an excellent opportunity for visit

ing this region so interesting from the point of view of hydro-electric development, it is expected that a large attendance from the east, as well as from the west, will be assured.

Vernon, B.C.

On March 10th by-laws were submitted in Vernon as follows: $15,000 for extensions to the power house; $50,000 for the purchase of electrical generating equipment; $35,000 for the reconstruction of the electric lighting system.

Winnipeg, Man.

Five 500 kw. transformers for the terminal station and No. 1 sub-station may be purchased.

City electrician, F. A. Cambridge, contemplates extension to the fire alarm system. Switchboard, batteries, etc., $10,000. Owner, Board of Control. Secretary, M. Peterson.

The purchase is being considered of 1 150 h.p. squirrel cage, constant speed, induction motor, 3-phase, 550 volts, 60 cycle, 720 r.p.m., and 1 40-h.p. squirrel cage, constant speed, induction motor, 550 volts, 3-phase, 60 cycle, 1200 r.p.m., for the city quarry at Stony Mountains.

Contract has been awarded to the Canadian General Electric Company for 3 2700 kw. transformers.

Woodstock, Ont.

The Woodstock and Northampton Telephone Company, Limited, are applying for incorporation. It is proposed to build and operate a telephone business in the parishes of Northampton and Woodstock and in the town of Woodstock.

Moonlight Schedule for April, 1913

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
Apr. 1	6 50	Apr. 2	5 00	10 10
2	6 50	3	5 00	10 10
3	6 50	4	5 00	10 10
4	7 00	5	5 00	10 00
5	7 00	6	4 50	9 50
6	7 00	7	4 50	9 50
7	7 00	8	4 50	9 50
8	7 00	9	4 50	9 50
9	7 00	10	4 50	9 50
10	7 00	11	4 50	9 50
11	10 10	12	4 50	6 40
12	11 40	13	4 50	5 10
14	0 30	14	4 40	4 10
15	1 10	15	4 40	3 30
16	1 40	16	4 40	3 00
17	2 10	17	4 40	2 30
18	No Light	18	No Light	
19	No Light	19	No Light	
20	No Light	20	No Light	
21	7 10	21	9 40	2 30
22	7 10	22	10 50	3 40
23	7 10	24	0 10	5 00
24	7 20	25	1 10	5 50
25	7 20	26	2 00	6 40
26	7 20	27	2 40	7 20
27	7 20	28	3 20	8 00
28	7 20	29	3 40	8 20
29	7 20	30	4 10	8 50
30	7 20	May 1	4 20	9 00

Total Hours 189 40

Tenders for Supplies

Sealed tenders, registered and clearly marked on the outside of envelope, "Tenders for Electrical Department Supplies," and addressed to the City Commissioners, Regina, Saskatchewan, will be received up until noon of **March 29th, 1913**, for the supply of:—

Section No. 1.—Weatherproof copper wire.
Section No. 2.—Western cedar poles.
Section No. 3.—Cross-arms.
Section No. 4.—Top-pins, insulators, etc.
Section No. 5.—Pole line hardware.
Section No. 6.—Pole type transformers.
Section No. 7.—Integrating watt meters, single, polyphase and two rate.
Section No. 8.—Metal flame arc lamps and station equipment.
Section No. 9.—Series cut-out mast arms for arc lights.
Section No. 10.—Underground material.
Section No. 11.—Fire alarm boxes and gongs.
Price to be F. O. B. Regina.
Copies of specifications may be had from E. W. Bull, Superintendent of Light and Power, Regina, Sask.

A marked cheque covering 5 p.c. (five per cent.) of bid must accompany each tender.

The City Commissioners reserve the right to reject any or all tenders.

E. W. BULL,
Superintendent of Light and Power.

5-6

Electrical News

Generation, Transmission and Application of Electricity

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Electric Lines as Local Improvement

The suggestion has been brought forward in Toronto that the payment for future civic car extensions should be made on the local improvement plan. Arguments in favor of this scheme are contained in a report just made to council by the chairman of the transportation committee, Ald. Dr. Wickett, by whom this plan, as applied to Toronto, has been introduced. The report quotes the opinions of engineers in Boston and New York in favor of this system, and also in the city of Schoeneberg, Germany, where a precedent for its application has been established.

At first flush the objection was naturally raised that this would open the way for a certain amount of scheming and wire-pulling by different sections of the city to have lines serve their property, but it is pointed out emphatically in the report, and we understand the intention of the transportation committee to be very decided in this matter, that any extension whatever must be a part of a general, comprehensive scheme of railway development which will be worked out and adopted by the city before this plan of extension is placed in operation at all.

The scheme has much to recommend it in principle, as the advantages and improvements introduced by a street railway compare in many respects with those of other local improvements such as sewers, good roads, water, etc. There is no doubt that all these improvements are alike in enhancing values of land in the section served. It is also a fact that the introduction of improvements into any new section tends to depreciate property in other sections, thus emphasizing the injustice to the general taxpayer of assessing him for improvements in any one section.

The system of assessment, however, is something that would have to be worked out with extreme care. A sewer benefits the street along which it runs, or a trunk sewer benefits uniformly the section it serves, but a street railway will benefit one part of a section more than another. If it is a residential section the land along which the railway runs will not in general increase in value to the same extent as land a little farther removed. In a business section, again, the reverse would generally be true, and it would need a very thorough knowledge of conditions, present and future, to determine these points. Again, it would appear that a section of railway nearer the centre of the city, in that it also serves the sections beyond, should in some measure at least, be paid for by those outlying sections.

Another difficulty seems to lie in the duplication of roads by municipalities and private companies. For example, the city's plan may mean the construction of a road through a section already served or soon to be served by a private line. In this case the local road would not carry the same advantages to the neighborhood it passes through and there would seem to be an injustice in assessing the land owners in that district on the plea of an increase in values which might have taken place from another cause entirely. This, again, would raise a very nice point in the adjustment of assessments.

It must be said, however, that the scheme is one which will appeal almost unanimously to the citizens living or owning land in the outskirts of the city of Toronto. There is very urgent need for railway extensions. The city and the local railway company do not appear to be able to co-operate and this solution of the difficulty would probably give the outlying districts railway service with less delay than any other plan that could be brought forward.

Water Powers of British Columbia

The Minister of the Department of Lands of British Columbia, Hon. W. R. Ross, who has jurisdiction over the waters of that province has just issued his annual report for the year ending December 31, 1912. The report contains results on progress made to that date on investigations of certain water powers including the Columbia, the Kootenay and smaller rivers and though covering only a small section indicates the great power possibilities of this province. Two sections of the Columbia river were covered (a) from the international boundary to Castlegar and (b) the Big Bend from Kinbasket Lake to Goldstream. There are no water power possibilities under (a) in the main river, but tributaries to this river showed a number of falls of appreciable size. On Cummins Creek which rises in the Rocky Mountains there is an average fall of 180 ft. per mile as far back as the river was followed with indications that 4,300 h.p. could be developed. Goose Grass Creek rising in the Selkirks averaged 520 ft. per mile for 2½ miles back from the source. Yellow Creek rising in the Selkirks was followed for 9 miles and showed falls as great as 736 ft. with an average of 500 ft. per mile. Wood River rises in the Rocky mountains and has a fall of 278 ft. Harvey Creek rising in the Rockies averages 245 ft. fall per mile for the first 2½ miles. Boulder Creek showed a fall of 330 ft. during the first mile. Soard Creek has an average fall of 350 ft. for the first mile. Gold Stream rising in the Selkirks and emptying into the Columbia 55 miles north of Revelstoke averages 160 ft. fall per mile for some distance back with more falls reported but not reached. Smith Creek rising in the Gold range showed an average fall of 250 ft. per mile as far as followed.

Kootenay River

The Kootenay River was investigated from its junction with the Columbia at Castlegar to a point about 6 miles from Nelson covering a distance of 18 miles. The total fall throughout that distance is 330 ft. and the discharges from

10,000 to 12,000 second-feet. The power possibilities include Upper Bonnington Falls already appropriated by the West Kootenay Power & Light Company and the City of Nelson, (b) the Lower Bonnington Falls utilized by the West Kootenay Power & Light Company, (c) a series of falls above Bonnington pool, giving a 77 ft. drop on a length of 3,200 ft. This will develop over 40,000 h.p., (d) a canyon 3¾ miles from the mouth of the river with a 42 ft. head in a distance of 5,300, giving 23,000 h.p. and (e) a site at Granite Bridge 6 miles below Nelson, the power of which has not yet been estimated. None of the tributaries of this river have been investigated.

Pend d'Oreille River

This river only lies in British Columbia for 16¼ miles of its course during which space it has a fall of 423 feet. The discharge is anywhere from 10,000 to 13,000 second-feet. Three places are particularly suited for the development of power (a) at the junction of the Salmon and Pend d'Oreille 48,000 h.p. under a 74 ft. head, (b) at 15 miles, 30,000 h.p. under 47 ft. head and (c) at 9 miles, 29,500 h.p. under 44 ft. head. The tributaries of this river are unimportant for water development purposes.

Elk River

The report also deals with an investigation of the Elk River canyon from a power standpoint. The Elk rises in the Rocky Mountains and after a 110 mile course joins the Kootenay River. In about 4.000 ft. there is a fall of 174.75 ft. and it is calculated that the power possibilities at low water is 13,500 h.p. This could be augmented by storage to double the amount. It is stated that the works at the power house, without distributing systems could be installed for $25 per h.p.

Temperature Effect on Insulations

The effect of temperature on insulating materials is always of supreme importance to the designing engineer, and in this connection a recent paper by Steinmetz & Lamme on "Effects of Temperature on Insulations," reproduced in the March 15th issue of the Electrical News, introducing a number of interesting recommendations, has aroused considerable interest. A treatise has also just appeared on the subject of alternating current machinery by Barr & Archibald who publish some original results on the effect of temperature on the dielectric strength of a varied number of insulating materials. In this connection the authors say:

It is well known that when most insulating materials are subjected to prolonged heating at high temperatures their dielectric and mechanical strength is permanently weakened. With a view to determining the temperature limits consistent with the safe working of electrical machinery, a number of investigations were made regarding the effect of heat on the electrical and mechanical properties of such insulating materials as are usually employed in electrical machinery, more especially in the construction of low-voltage armatures and transformers. A number of specimens of various insulating materials were for a period of nine months kept in electrically heated ovens maintained at the temperatures 75 deg., and 100 deg., and 125 deg. C. respectively. The alternating pressure required to rupture these specimens was determined both in the case of the specimens heated to the different temperatures, and also in the case of a similar specimen which was not heated at all. As the results of the investigations form an important contribution to the literature on this subject, the results of some of the tests are reproduced in the accompanying table. The disruptive tests were carried out whenever possible on specimens which were placed between circular electrodes 5 square centimetres area, the upper one being loaded with a total pressure of 2 kilogrammes. In the case of tapes, etc., two rods 6.3 millimetres diameter were used with hemispherical ends, the pressure being 25 grammes. The voltage supply gave a sinusoidal e.m.f. of 50 periods.

The results of these tests show that most insulating materials improve when heated up to 75 deg. C., do not seriously deteriorate by further heating to 100 deg. C.—in some cases they actually improve—but show a rapid deterioration on heating to 125 deg. C. The initial improvement in dielectric strength is, of course, due to the expulsion of the enclosed moisture. The tests also showed that prolonged

Material.	Thickness in Millimetres.	Temperature in Degrees C.	Average Disruptive Voltage.	Volts per Millimetre.
Press-spahn . . .	0.25	Normal	2843	11,400
		75	2640	10,560
		100	2778	11,100
		125	2888	11,550
Press-spahn . . .	0.6	Normal	5497	9,100
		75	5403	9,000
		100	5289	8,800
		125	5348	8,900
Press-spahn varnished	0.35	Normal	7696	22,000
		75	6243	17,800
		100	6787	19,400
		125	7600	21,700
Manilla paper . .	0.30	Normal	1847	6,150
		75	1712	5,700
		100	1800	6,000
		125	1613	5,370
Manilla paper varnished	0.355	Normal	3270	9,200
		75	4800	13,500
		100	5043	14,200
		125	8058	22,700
Mica linen . . .	0.23	Normal	2826	12,300
		75	3383	14,700
		100	3618	15,700
		125	3288	14,300
Mica paper . . .	0.125	Normal	2403	19,300
		75	2875	23,000
		100	3500	28,000
		125	2840	22,700
Oiled linen . . .	0.20	Normal	5750	28,750
		75	5826	29,100
		100	6623	33,100
		125	5124	25,600
Varnished canvas . .	0.40	Normal	7025	17,500
		75	5833	14,660
		100	3014	7,550
		125	1598	4,000
Dynamo tape . .	0.18	Normal	...	...
		75	760	4,220
		100	709	3,940
		125	896	5,000
Superfine dynamo tape .	0.11	Normal	485	440
		75	493	4,480
		100	487	4,400
		125	Perished	...

the mechanical properties of press-spahn and oiled fabrics. At 100 deg. C. these materials showed signs of deterioration after a few months and perished on further heating. At 125 deg. C. most of the specimens were much discoloured and deteriorated after a comparatively short time, the only material remaining in a fair condition at the end of nine months being micanite; but even this had suffered to some extent, due to the charring of the shellac adhesive used.

The efficiency of the transformer is 90 per cent. or more; of the steam locomotive 20 per cent. or less. To which class do **you** belong? Are you returning your employer in useful work 90 per cent. of what he pays you—or only 20 per cent? Think it over.

Get the Consumer Interested

Mr. R. B. C. Hammond, superintendent of light and power for the city of Vernon, B.C., has hit upon a useful method of drawing the attention of electric users to the various kinds of household equipment which may be had now-a-days at small cost. A sheet has been prepared showing the consumption of various household electrical appliances, the period through which they are likely to be required each time they are used, and the cost of that period. These are sent out with the bills every month and are said to be greatly appreciated by all the customers. A power rate of five cents per kilowatt hour is allowed the users of household equipments when a separate circuit and meter is installed. The list as sent out, with the information attached, is as follows:

Article	Average Watt Hour Consumption	Period of Operation Minutes	Cost during that Period Cents
Chafing dish	400	20	3/4
Pint milk warmer	250	6	1/8
Quart food heater	500	6	1/4
Coffee percolator	300	20	1/2
Stove, 6 inches	500	15	5/8
Stove, 8 inches	800	15	1
Broiler, 9 x 12 inches	1200	15	1½
Curling iron heater	60	15	3/40
Iron, 3 pounds	250	30	5/8
Iron, 6 pounds	500	30	1¼
Frying pan (7 in. diam.)	500	30	1¼
Waffle iron	500	12	½
Tea kettle	300	20	½
Glue pot, 1 quart	300	20	½
Soldering iron, 2 lbs.	200	30	½
Doctor's sterilizer	1000	30	2½
Bathroom radiator	1000	30	2½
Heating pad	50	60	¼

Splendid C. G. E. Report

The annual report of the Canadian General Electric Company for the year ending December 31, 1912, shows profits, before providing for depreciation and interest on borrowed capital, of $2,011,719. Interest and depreciation charges amount to $615,236, leaving a net profit for the year of $1,396,483. Dividends on preferred and common stock amount to $689,871, leaving a net surplus for the year of $706,611. $700,000 was added to reserve account which now stands at $2,369,531. This amount, added to the balance at credit of profit and loss account of $682,391, brings the total surplus to $3,051,922. The capital liabilities of the company are $2,000,000 of preferred and $8,000,000 of common stock, with mortgage obligations and bonds of subsidiary companies amounting to $905,567.

The officers of the company are now as follows: W. R. Brock, hon. president and chairman of the Board; Frederick Nicholls, president and general manager; W. D. Matthews & Hon. J. K. Kerr, K.C., vice-presidents; Sir Mortimer Clark, Hon. Geo. A. Cox, A. E. Dyment, Sir Rodolphe Forget, H. S. Holt, Hon. Robt. Jaffray, Sir Wm. Mackenzie, Jas. Ross, F. G. Osler; J. J. Ashworth is secretary and assistant general manager.

An Automatic Sewage Pump

In the town of Medicine Hat there is an interesting automatic sewage pumping outfit. During the flood periods the natural flow of sewage cannot force itself into the Saskatchewan. To overcome this the city has installed a duplicate plant consisting of a centrifugal pump of the Northey type, direct connected to a C.G.E. 15 h.p. motor through a flexible belt laced coupling. The motors are controlled by C.G.E. automatic compensators which in turn are controlled by a single pole switch and float ball.

When the plant is put in operation, the sewer discharge to the river is shut off, and settlement takes place in a well in which is immersed the suction pipes of the pumps. The discharge pipe from the pumps joins on to the main sewer discharge outside the pump house and runs out 900 ft. to the centre of the river. The units are guaranteed to pump 500 gals. each per minute, against 24 ft. head of water, plus friction losses.

The main feature of the outfit is that it starts and stops automatically as predetermined levels, and only requires to be looked at once a day, to fill up oil cups for the guide bearings on the 22 ft. vertical shaft. The weight of the pump impeller and shafting is taken by the main thrust ball bearing in the sub-base of the motor. As the motor rotor is also hanging from a ball bearing, it will be seen that little power is required to run the unit without load. These units were supplied and installed by the Canada Foundry Company's Calgary Office.

Petty Dishonesty

A case of more than ordinary interest to electrical companies came up in the Ottawa police court on March 19th, when the Ottawa Electric Company charged Jacob Bercovitch, a second-hand storekeeper, with fraudulently converting to his own use a number of electric lamps, the property of the company. Bercovitch buys the light for his store on the commercial or flate rate basis, under which system the company does not supply free lamps. His house, however, is supplied through a meter, on domestic rates, for which lamps are supplied free of charge. The allegation made against Bercovitch was that he applied for a number of lamps at the company's offices, saying they were for his house, but instead of using them there he used them in his store. For some time the company had been suspicious about this practice being followed so the lamps were marked when given out to customers who used the two systems.

The magistrate, before whom the case was tried maintained that the case was one for the civil courts. Mr. A. W. Greene, counsel for the company stated in court that through such corrupt practices the company loses about $10,000 yearly. Further prosecutions are to follow and a direct charge of theft is to be laid as the company is determined to stop this system of petty dishonesty.

Wireless Extensions

Mr. J. H. Lauer, the manager of the Marconi Wireless Telegraph Company of Canada, in an interview stated that three Marconi stations communicating between Lake Superior and Lake Huron were built last year, and the new station at Sarnia now under construction, will be in commission at the opening of navigation. This will give a direct through communication from Port Arthur, at the head of Lake Superior, down to Sarnia, at the foot of Lake Huron. It was also the intention of the government to proceed with the construction of a station at Port Stanley, on Lake Erie and Toronto and Kingston, on Lake Ontario. This would make complete the entire chain of stations from the head of navigation on the Great Lakes to Cape Race, the extreme eastern limit of Newfoundland.

At the present time there is through communication between Montreal and Cape Race. The apparatus at the latter point has now a steady radius of between four and five hundred miles, and can reach ships from 1,200 to 1,500 miles east of New York. The average range for the standard set for small ships has a radius of 200 miles, but the large liners carry a much more powerful apparatus.

During the past summer wireless engineers explored the great rugged strip of the Labrador coast and the immense wilds lying around Hudson Bay, with a view to linking them with the rest of the world by the Marconi system. Further expeditions will continue this work as soon as spring opens up.

Equipment for Calgary

The city of Calgary is now installing a 1,000 kw. d.c. auto-synchronous motor-generator, supplied by Messrs. Kilmer, Pullan & Burnham and manufactured by the Swedish General Electric Company. They are also now arranging to install a 1,000 kw. d.c. Dick-Kerr synchronous motor-generator. Both of these motors will be used for supplying power to the municipal street railway system. It is further expected that in the course of the next thirty days a 2,500 kw. turbo-generator, Belliss & Morcom type, and supplied by Messrs. Laurie & Lamb, will be installed in the main power station.

The city has sent a repeat order for a 500 kv.a. oil-insulated single-phase 12000/2400 volt transformer to the Packard Electric Company, which transformer will be installed in the Ogden substation, and will complete two banks of three transformers of the same size. This substation is used for supplying power to the C. P. R. shops, also for the operation of a motor generator for street railway purposes. They have also repeated an order to the Canadian Westinghouse Company for one 3,000 kw., three-phase 12,000/2400 volt transformer—a duplicate of two now in operation in the city.

A by-law was voted on, March 5th, authorizing the sum of $400,000 for the erection of additional sub-stations and equipment, also for underground cable and light and power extensions in the various parts of the city. Estimates for street lighting have been prepared which show that $105,000 will be required for 1913, as compared with $59,000 for the year 1912.

Westminster Power Company

Plans are now under way for the establishment of an extensive hydro-electric power plant by the promoters of the Westminster Power Company, Limited, a concern which came into prominence recently through its applications for extensive water rights in the vicinity of Vancouver, with a view to generating electric power for transmission to all parts of the New Westminster and Vancouver water districts. The application in the B. C. Gazette for approval of the undertaking, is signed by Messrs. G. E. Corbould, president, and J. R. Grant, secretary, members of the firm of Corbould, Grant & McColl, solicitors, New Westminster, but the names of those promoting the scheme have not yet been disclosed. The plans of the company, which have been filed at the provincial government offices in New Westminster, show the hydro-electric development to be located in section 33, on the Indian River, close to the upper end of the North Arm of Burrard Inlet, and only a few miles distant from the main generating station of the Vancouver Power Company—a subsidiary concern of the B. C. Electric Railway Company.

The plan is a most comprehensive one, involving the harnessing of numerous small streams at a high elevation above the power house, and piping the water down to the plant where great volume and force are obtained. One of these sources of power is designated as Lake No. 2, located at an elevation of 1,926 feet above the power plant, and about 3½ miles distant. Lake No. 1 is 2,114 feet above the power house, and about an equal distance away in a more northerly direction. Dams across the ends of both lakes are shown, these serving the purpose of raising the lake level and increasing the amount of the storage water.

The streams from which the water supply will be captured are: Hixon Creek, a creek flowing into the Mesliloet (Indian) River from the east through township 6; Brandt Creek, a creek flowing into the Mesliloet River from the east through township 7; Young Creek, flowing southerly into Brandt Creek, and Norton Creek, flowing westerly into Brandt Creek. All of this water is led to the forebay, whence it is piped to the power house. The plans state that the effective head of water will be about 1,800 feet. The plans have been filed in the government offices pursuant to the requirements of the Water Act.

Social and Luncheon Club

The social club connected with the office organization of the British Columbia Electric Railway Company at Vancouver, B.C., has recently entered upon a new field of activity by the organization of a Luncheon Club. This auxiliary organization has as its aim the furnishing of a daily luncheon at moderate cost to its members. The plan has now been in actual operation for several weeks and the results seem to indicate that it will be successful. The management of the B. C. Electric loaned to the club the entire initial outfit, including the full equipment for a gas kitchen, china, cooking utensils, furniture, etc., as well as providing the cost of alterations incident to the arrangement for a kitchen and dining room, the outlay being about $1,500. The Social Club gave part of its games room for use as a kitchen and the balance of this room is used during the lunch hour for dining quarters, the room being changed again for the purpose of games at night.

The price charged for meals is $1 for the five days of the week, no meals being served for less than one week. From 100 to 125 persons have taken advantage of the offer during the first two weeks of the Club's operations, and it is probable that the membership will grow now that the organization has been successfully launched. The government of the club is vested in a committee of five, selected by the members, a representative of the company management and a representative of the Social Club. The only help employed by the Club are a chef and his helper, the luncheon being arranged on the cafeteria plan, each member waiting upon himself. The result of the first week's operation of the Club was a deficit of $12, but on the second week this deficit was turned into a balance of $6, this showing demonstrating that it is possible to work out the objects for which the club was organized. The members of the staff generally agree that the project is a good one as the Luncheon Club affords the members an opportunity of securing a substantial mid-day meal at a moderate price, the food and service provided being far better for the money than it is possible to obtain at the public dining places in the city.

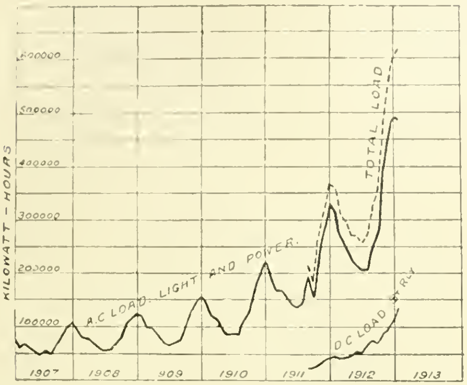
One of the best results of the Luncheon Club has been that it brings the men who usually meet each other only hurriedly and in a business way, to the club quarters where they meet round the dining table in social intercourse, and thus become better acquainted with each other. The provision made by the Social Club of reading room, billiard room, social hall, etc., adjoining the dining room makes the after dinner gatherings to the various quarters a real pleasure for the employees of the company.

Regina Doubling Each Year

As illustrated in the accompanying curves, the output of the Regina electric light plant is practically doubling each year. This curve shows the monthly output for a number of years past. Under these conditions it is interesting to note

the rates charged for light and power in Regina. These are given below and it will be noticed that this is one of the few Canadian points where two-rate meters are being used.

For light used in one installation and registered in one month on one meter:—First 300 kw. hours at 7c; all used in excess of 300 kw. hours, 6c per kw. hour. Light used in the day time (off peak hours) on two-rate meter in installations of over 5 kw. of maximum demand, 5c per kw.h.



Curve showing monthly output of Regina electric plant

For power used in one installation and registered in one month on one meter:—First 300 kw. hours at 5c per kw.h; 300 kw.h. to 600 kw.h. 4c; all in excess of 600 kw.h. 3½c. For power used in day time on two-rate meters in installations over 5 kilowatts of maximum demand, 3c per kw.h.

Energy for heating and cooking is supplied at power rates. A discount of 10 per cent. is allowed for payment within ten days. A minimum rate of $1 per month is charged on all light services and $1 per month per connection on power services, or kw. of demand for heating services.

Special rates are arranged on large power services according to the condition of service. Meter rental for light is 25c per month, for power 50c per month and for two-rate meter 50c per month.

Lethbridge Annual Report

The following figures, from the annual report of Mr. Arthur Reid, General Superintendent of Light, Power and Street Railways for the city of Lethbridge, Alta., are indicative of what capable management coupled with western activity can produce.

The Electric Department granted 495 permits for wiring both motors and lights, made 386 new connections and read an average of 1,451 meters every month. Inspection fees collected amounted to $327.00. Our line construction was as follows:—New pole line, 3.7 miles; new wires strung on existing poles, 5 miles; street lighting wires on wooden poles, 3.6 miles; street lighting wires on iron poles, 7,000 feet; fire alarm wires, 2 miles; police telephones, 4.7 miles; there was also placed in service 86 cluster posts, 4 lights each; 2 electric signs on the 9th street bridge and four 5-light standards in the Galt Gardens.

The distribution system at the present time is made up of the following:—

	kw.
Total number of transformers	251
Total capacity of transformers	1,522
Capacity of lighting transformers	948.8
Capacity of power transformers	573.2
Lighting, connected load	1,254.5
Power, connected load	584
Total, connected load	1,838.5
Number of light and power consumers	1,627

The 1912 financial statement is as follows:—

Revenue	$120,364.26
Expenditures	96,952.25
Profits	$ 23,412.01

The 1912 expenditures were distributed as follows:—

Salaries	$ 3,527.00
Power house wages	11,554.19
Fuel, water and electricity	17,852.24
Water	720.00
Oil and waste	979.99
Plant repairs	3,731.28
Poles, wires and meter repairs	1,289.83
Street lighting maintenance	3,771.69
Interest and sinking fund	35,735.57
Meterman's wages	1,080.00
Power house expense	688.33
Sundries	2,549.22
Rebates on guarantee deposits	2,489.00
Wiring inspections	871.43
Discounts	7,112.48
Total	$96,952.25

In the power house a large amount of construction work has been done consisting of the addition of a 1500 kw. turbo-generator; four boilers totalling 1,140 h.p.; one 320 tube economizer; one 50 kw. exciter engine and generator; draft apparatus; addition to boiler room and switchroom and one new feed pump. This brings the total capacity of the power house up to 2,440 kw. The electric output was 2,250,300 kw.h. Total water pumped was 417,317,000 Imperial gallons; maximum quantity pumped per month 43,062,000 gallons in June; minimum quantity 26,713,000 gallons in February; maximum daily consumption 2,023,000 gallons on June 26th. Coal consumed for electricity 8,091 tons. Coal consumed for water pumping 1,814 tons. Total coal consumed 9,905 tons.

Cost is 1.2c. per kw.h.

The cost of production of energy per kw.h. during the last two years is as follows:—

	1912 c. per kw.h.	1911 c. per kw.h.
Coal cost	.647	.604
Labor cost	.513	.67
Plant repairs	.016	.208
Oil and waste	.043	.057
Water	.031	.043
Sundries	.030	.023
Total	1.280c.	1.605c.

This shows a slightly lower operating cost per unit in the power plant during 1912, which is largely due to the increased load and better operating conditions. These costs are figured on a basis of 8,760 hours which was the total number of hours the plant was in operation during the year.

"Facts and Factors" of Lethbridge Municipal Plant

Population	12,000
Consumers per 100 of population	13.56
Station rating, kw.*	2440
Station rating per employee, kw.†	78.7
Station rating per capita, watts	203.3
Ratio of station rating to connected load, per cent.	75.
Average load during operation, kw.	305.

Ratio average load to station rating, per cent.	12.5
Annual load factor, per cent.	32.
Investment per kw. of rating	$210.00
Investment per capita	42.66
Gross income per kw. of rating	49.32
Gross income per consumer	73.97
Gross income per capita	10.03
Gross income per $100 invested	0.0534
Gross income per kw.h. generated	0.0534
Ratio of expense‡ to gross income, per cent.	85.
Net earnings per $100 invested	$4.57
Total hours operations for the year	8,760
Connected load	kw.
Incandescent lamps	1254.5
Motors	584.
Total load	1838.5
Metered services	1,627
Full-load rating of plant, kw.	2,440
Maximum load, kw.	800
Transformers	kw.
Light	948.8
Motors	573.2
Total transformers rating	1522.

*Full load capacity of plant.

†Entire force, station, distribution, clerical and general.

‡Includes interest and taxes but not depreciation.

Electric Machinery Design

At a meeting of the Montreal Electrical Society Prof. Alex. M. Gray, B.Sc., assistant professor of electrical engineering, McGill University, lectured on the "Construction of Electrical Machinery." The lecturer stated that the purpose of the address was to give in a simple manner an explanation of the fundamental principles on which the operation of electrical machinery depends and to point out the recent developments in the subject and particularly the limitations which are met. The fundamental principles of the electro-magnet, the generation of electromotive force, and of commutation were taken up, and the application of these principles in actual machines was pointed out and illustrated with lantern slides. The following points of interest were brought out.

Every electrical machine, as for example, an alternator, consists of a magnetic circuit of iron, an electric circuit of copper, and a separating medium of insulating material to prevent the copper, which is at a high potential, from coming in contact with the iron, which is connected to the ground. This insulation is the weak point about such machinery because it consists principally of paper, cotton and mica, none of which are very strong mechanically, and the two former become very brittle when subject to a temperature greater than 90 deg. cent. and then pulverize due to vibration. Overloading a machine increases its temperature rise and increases the chance of damage to the insulating material.

Forced Ventilation

Some pictures of turbo-alternators were shown and it was pointed out that in order that the machine be quiet in operation at the high speeds, and also that they may be effectively cooled, it is necessary that they be totally enclosed and cooled by forced ventilation. A 6000 kilowatt ampere machine requires 25,000 cubic feet of air per minute for effective cooling, and if even a small amount of dust be in the air it will soon clog up the air passages and then the machine will overheat; the air for such machines should therefore be filtered through cheese cloth or be passed through a spray of water before it enters the machine. The water vapour carried into the machine in the latter case has not been found to condense on or to damage the insulation.

Due to the enclosed construction and to the depth of iron surrounding the rotating part of a turbo-alternator it has sometimes been stated that even should such a machine run away and the rotor burst no damage to external objects would be done because the flying parts of the rotor could not get out. This has not been found to be the case; when one of these machines did burst on an overspeed run some parts of it could not be found, some were found half a mile away, and there was a large hole found in the roof of the building. The surface speed of a turbo rotor is about 4.5 miles per min. at normal speed and they are all tested at 25 per cent. overspeed, the turbine itself is supplied with an overspeed device which cuts off the steam supply when the machine runs to 20 per cent. above normal speed.

Water wheel generators have to be built so that they can run safely up to about twice normal speed. The blades of a water turbine run at about half the speed of the water flowing. If then the load on the alternator is suddenly released, due for example, to the opening of a circuit breaker, the turbine will speed up till the blades are running at about the same speed as the water or at about twice normal speed. It is not possible to throttle a large volume of water in the short time that it takes the machine to speed up, so that all specifications for alternators to be connected to water turbines should call for a test to be made on the machine at twice normal speed to ensure that it is mechanically strong enough.

In introducing the subject of high voltage transformers it was pointed out that a few years ago the limit of voltage of a long distance transmission line was 66,000 volts, because the insulators for such voltage had to be long and, if of the pin type then in use, were not mechanically strong because they were subject to bending. With the introduction of the suspension insulator the line insulation problem was solved and the voltages were increased to 110,000, at which point it was found that the transformers were beginning to give trouble. Much experimental work on high voltage transformers has been done by the different manufacturing companies and many of the insulation problems solved, so that now there are in operation transmission lines of 150,000 volts with transformers operating at that voltage in the open air, and no one would say that the limit of voltage had been reached at that point.

D.C. Transmission

In competition with the high voltage alternating current system the Thury direct current system has made some progress and, under special circumstances, is the only thing that can be used. With this system, at present, voltages as high as 90,000 are used, but such voltages have to be generated in revolving machinery with commutators, because in the d.c. system there is no piece of apparatus to take the place of the transformer. So far it has not been found possible to build commutators commercially for more than 4,500 volts, so that for a 90,000 volt station twenty commutators connected in series are required and this does not appeal to Canadian engineers as being the acme of safety, especially as each of the generators have to be insulated from the ground and have also to be insulated from the turbine driving them by insulated couplings. Still further, the receiving station requires the same number of machines which must again be connected to alternators because the distribution of power is carried out by alternating current. It is evident then that such a system is complicated so far as the power station and the sub-station are concerned, when the power is delivered in bulk, and that only a great saving in the line would compensate for all the other complications. It is in the line that the Thury system is simple. It is possible to build cables for 90,000 volts d.c. and the power can be trans-

mitted through a single cable and the ground used as a return.

In densely populated countries, where the cost of a 200 mile right of way would be exorbitant, then the Thury system may be considered and the line laid as a single underground cable. In the proposed transmission from Trollhattan to Copenhagen, where there is 3.5 miles of water to cross, the Thury system has been recommended because a cable can be built for high voltage d.c. to be laid and operated under water, while an a.c. cable cannot be built and a transformer station would be necessary to reduce the voltage to 20,000 at which value power could be then transmitted across the water by a submarine cable.

The lecture closed with a discussion of transformer cooling, the several methods being shown by slides. For small sizes the transformers are placed in a tank which is filled with light oil; this oil circulates due to the heating of the transformer and carries the heat from the hot points to the tank from which it is dissipated to the air. For larger sizes a plain tank has no longer sufficient surface and the tanks are corrugated or are even cooled by external pipes which are connected to the tank at the top and bottom and give a large increase of tank surface and a greater cooling effect for a given floor space. Then finally the water cooled transformer was shown which is cooled by circulating water through water pipes in the top of the tank to which coils the heat is carried by the oil; it is important that the water used for such cooling does not contain sediment because this will clog up the pipes and spoil the cooling effect.

The lecture was followed by considerable discussion on the part of the members of the society, such questions as corona formation, wireless transmission of power, strains on the end turns of transformers and sub-synchronous speeds in induction motors being taken up. During the course of the talk, Mr. Gray referred at some length to his article on "Homopolar Induction Machines," which appeared in the March issue of the Electrical News.

Western Canada Power Company

Much interest was aroused at the coast recently by the announcement of Mr. Wm. McNeil, general superintendent of the Western Canada Power Company, to the effect that the company is contemplating the construction of a power line across Burnaby Municipality to the North Arm of the Fraser River. This line would supply power to a large portion of Burnaby, the manufacturing sites along the North Arm of the Fraser, and on Lulu Island.

While it is understood that a definite route has not yet been decided on, it is thought probable that the line will commence at the Ardley sub-station of the company, and extend along the Royal Oak road to the northern shore of the North Arm of the Fraser. In order to cross the river, the company is considering the advantages of a submerged cable which would carry the power to Lulu Island at minimum expenditure without interference with the shipping. The construction of this line will be of great benefit to the entire Burnaby district, and will stimulate industrial progress in a section of the municipality which has hitherto enjoyed but few advantages in electrical power development.

Twenty Miles During 1913

The result of a recent conference held between Hon. Thos. Taylor, Provincial Minister of Public Works and Mr. Wm. McNeil, assistant general manager of the Western Canada Power Company, and chairman of the Burrard, Westminster, Boundary Railway & Navigation Company, is contained in the announcement that the Government of British Columbia will this year expend $200,000 on the construction of the combined railway and traffic bridge across the Pitt River, to be used by the railway company. It is estimated by the government authorities that this bridge, which will be completed in 1915, will cost upwards of $700,000.

The Western Canada Power Company on its part undertakes to commence the construction of some twenty miles of railway this spring between Stave River and Pitt River, and to complete the work by the end of the present year. This is a section of the electric road to be ultimately constructed by the company along the north bank of the Fraser River between Mission City and Vancouver.

Certain amendments to the railway company's charter are being applied for during the present session of the Federal Parliament, also an extension of time for the completion of the railway. As soon as these have been granted the work of construction between Stave River and the Pitt will be commenced.

Light and Power in Fraser Valley

By the terms of a recent agreement with the municipality of Matsqui, Fraser Valley, B.C., the Western Canada Power Company, Vancouver, commenced the erection of pole lines early in March to supply current for light and power purposes at all points throughout the district. Under its contract, the company is to complete about ten miles of this line within ninety days, from the date of starting work. In addition to the construction of many miles of line for local distribution, an agreement has been reached with the council by which the company is authorized to build and maintain the big transmission line from its main generating station at Stave Lake through Matsqui to Sumas. Four miles of the latter line will run through Sumas municipality, and for the use of the highway, the company will pay an annual rental of $400.

Lines will also be erected by the company at an early date to supply power to the pumping stations at the government dyking project in this district. Here by the use of electricity the cost of operating has been considerably reduced. A number of other larger users of power will profit materially by the introduction of cheap electric power in the district.

Fraser Bridge Illumination

The provincial government is seeking an arrangement with the Western Canada Power Company whereby the company will agree to install the lamps and furnish the light across the southern half of the Fraser River bridge at New Westminster, thus completing the lighting equipment of the structure. The proposal to employ city lighting was abandoned owing to the refusal of the New Westminster city council to supply light for less than 5 cents per kilowatt hour, a rate which the government authorities considered exhorbitant.

Important Coast Developments

Extensive as has been the hydro-electric development of the lower mainland of British Columbia, the future of the whole of the Fraser River region in the production of electric energy by the utilization of the water powers tributary to this great river, is such as to arouse the liveliest imagination. The latest proposition to harness some of the mountain streams which is attributed to the Mackenzie & Mann interests, calls attention again to the vast resources of the province in this respect.

Not only throughout the lower mainland, but right up the valley of the North Thompson to the Yellowhead Pass, the development of power will, in time, be a feature of the economic progress of these regions. It means intensive settlement, a greater volume of agriculture and manufacturing, and an increasing and prosperous trade for all sections and especially the coast cities of the province.

For some time past the Mackenzie & Mann interests have been active in securing water rights at various points on the line of the Canadian Northern Pacific Railway in British Columbia, and recently the authoritative announcement was made that the company intend to supply light and power to Port Mann and other points on the line, as well as to electrify the entire stretch of road from Yellowhead Pass to Port Mann, and ultimately between Port Mann and Vancouver. One of the biggest projects of the railway builders is to erect two dams across the valley just east of Hope, where the Nicolum River empties into the Coquahalla, and erect a hydro-electric plant, at the confluence of the two streams, capable of developing some 30,000 horse-power under a head of 1,800 feet. In addition to the power from the Nicolum and Coquahalla it is also planned to drive a tunnel through the Divide to the Sumallow River level, and this stream will then be in part diverted from the Skagit to the Nicolum. The water will be held there in a huge storage reservoir with a capacity of 10,000 acre feet. From this storage reservoir to the generating plant, the water will be conveyed by penstock or tunnel. The company expects to divert 150 cubic feet of water through the tunnel to the Sumallow to add to the large volume of water carried by the Coquahalla and Nicolum rivers.

Generating Plant near Hope

The generating plant will be situated about four miles east of Hope Station on the Canadian North Pacific Railway. One of the dams will be ten miles from Hope and the other about 12 miles further eastward. The point of diversion of the Sumallow, which will form the second dam and storage reservoir, will be some twenty-one miles from Hope.

Mr. L. N. Jenssen, division engineer for the Canadian Northern Pacific, who has been engaged in surveying and staking the project, is now engaged in preparing plans and formulating the entire scheme. Application for the lease of the water rights in the Hope district has already been made to the water recorder at Ashcroft.

It is interesting to note in this connection, that the C. N. P. Railway has definitely decided to electrify the branch line from Kamloops to Vernon. Mr. R. A. Barton, who was the engineer in charge of the preliminary development of the Couteau Power Company, near Ducks, just north of Kamloops, stated recently in Victoria that the C. N. P. Railway has acquired the charter and interests of the Couteau Power Company, and it is believed the company will utilize the power plant to electrify the branch line into the Okanagan district. This power company had previously provided for the expenditure of $2,000,000 in development work, and it is understood this will be undertaken by the railway company. Should the work be carried out as planned the C. N. P. line in the Okanagan will be operated as an interurban line, thus effecting a considerable saving in its operation.

Rights at Other Points

The company holds water rights and licenses at other points in the interior of the province with the apparent intention of their use in electrical propulsion of trains across the continent. Under the Mackenzie & Mann charter in British Columbia, current may be sold at any point on its system, or any use may be made of it, so that within the next few years it is quite possible the company may prove an active competitor in the field of power supply in the lower mainland.

Should the C. N. P. Railway definitely decided to electrify its entire mountain division the company will be following the example of the Great Northern and Northern Pacific companies, which are also adopting that course.

It is now generally understood at the coast that the Canadian Pacific Railway intends to operate its trains through the projected tunnel at Glacier, B.C., by electricity, and that the generating plants to be erected by the company at Illecillewaet and on the Kicking Horse River, will be large enough to supply power for the whole of the Mountain division. It is believed that electricity will be used on the company's lines through the mountains as soon as the tunnel is completed.

An Electric Truck Campaign

A campaign has been inaugurated this spring in the coast cities of British Columbia for the introduction of electric vehicles. Over 5,000 autos are now in use in British Columbia, the great majority of which are used at points near the coast. Hitherto the gasoline car has been the prevailing type with a small scattering of electrics. The energetic campaign which is being inaugurated this spring, however, has resulted in bringing electric vehicles before the public until they now occupy a position which bids fair to make them a real competitor of the gasoline car for public favor.

The campaign is being carried on for the production of both pleasure vehicles and commercial cars. Nearly all the types of electric vehicles are represented on the coast by agencies which for some years past have been selling a small number of cars annually. The introduction of these cars with their advantages of cleanliness, silent running, ease of regulation and low cost of maintenance and operation has attracted attention to the type of vehicle and renders the advance campaign which is being carried on this spring much easier than it would otherwise have been. Accurate statistics as to the number of electric pleasure cars in service in Vancouver and Victoria are not available but reports from the agencies indicate that the total is now

B. C. E. R. Co's. Electric Trucks

worthy of note and that it will probably be doubled before next season. One firm in Vancouver which operates a garage has made an attractive offer in connection with the sale of electrics. This concern provides for the garaging of the electric, charging of battery, delivering and collecting vehicle daily for $30 per month, thus placing at a cost of $1 per day an electric pleasure vehicle at the service of the owner.

In the field of electric trucks, the B.C. Electric Railway Company this year took out an agency for the General Vehicle Company and have been pushing the claims of electric trucks vigorously in Vancouver. This concern is now operating a fleet of 5 electric trucks in connection with its Vancouver light and power service and it is probable that this

number will be increased shortly. The firm reports that there is now in Vancouver a 3-ton electric truck which has been in constant service for the last seven years and is today still giving perfect satisfaction although constantly on the road. In Victoria a number of electric trucks are in service and the list will be increased this season through repeat orders by satisfied users of the equipment and new firms which have been won over by the records shown by the vehicles in actual operation.

To satisfy the demand for current for electric trucks, public charging stations are maintained by the B.C. Electric as well as a large number of private firms operating garages. There are at least nine public stations in Vancouver in addition to the eight charging stations maintained by the B.C. Electric at its various sub-stations. On Vancouver Island there are eight public charging stations operated in connection with garages. In addition to these public stations there are a large number of charging equipments installed in private garages. The B.C. Electric make a maximum charge of 5 cents per kw. hour for current for electric vehicles, this amount being reduced as the consumption increases.

Viewing the field as a whole it is stated that the outlook for electric vehicles on the Pacific coast is excellent. At the present time both on Vancouver Island and the British Columbia mainland public authorities are taking an active interest in the subject of good roads.

B. C. E. R. Sub-station Changes

Operations have been started by the British Columbia Electric Railway Company on the construction of a large receiving station which will regulate the distribution of current to the company's territory on the southern mainland of British Columbia. The site for the building is in D. L. 118 Burnaby, just on the boundary line of the city of Vancouver where the company has a large tract of land. The total expenditure to be made on the property is estimated at $250,000. The buildings to be erected on the site are two in number, a main receiving station and a small sub-station. Both will be of steel frame and reinforced concrete type of construction and fireproof throughout. They will be one storey in height with an additional storey for the transformer galleries.

In the receiving station there will be four incoming lines delivering the current at 60,000 volts. The electrical equipment will consist of four banks of three transformers, each with a total capacity of 36,000 kw., by which the current will be stepped down from 60,000 volts to 11,000 volts for distribution to the sub-stations.

The sub-station, which will be erected in connection with the receiving station, will be equipped with two motor generator sets and a bank of 11,000/2,200 volt transformers. From this station will be regulated the supply of current for railway purposes and for public and private lighting in the vicinity of the station.

Only One High Pressure Station

The electrical equipment of both stations includes the usual installation of a full equipment of lightning arresters, switching apparatus, etc., the company's electrical engineers having designed the stations in accordance with the latest methods followed by central station and electric railway companies. At the present time the current from the company's generating station is sent to the Vancouver sub-station and other sub-stations at high voltage. When the new sub-station is completed, the Vancouver station and other stations now connected with the transmission lines will be used as sub-stations, receiving their current at 11,000 volts from the Burnaby station. In connection with the new arrangement the B. C. Electric will reconstruct its transmission system from the power house on the North Arm of Burrard Inlet to Burnaby, in order to enable the current to be carried at 60,000 volts.

As soon as the Burnaby receiving station is completed the company is planning the erection of a similar station near Sapperton, just on the outskirts of New Westminster. The equipment of this plant will be almost identical with the Burnaby station and the plans call for an expenditure of about $200,000. From the Sapperton station, power will be sent to the company's sub-stations in the South Fraser Valley, which cover the supply of the Fraser Valley interurban line and the demands of private parties for light and power in the district at 34,000 volts. From this point will also be distributed the current for the various sub stations lying to the east of Sapperton. In the plans, arrangement has been made whereby in case of accident to the transmission line, current from either the Burnaby or Hastings station may be supplied to any point in the company's territory.

Another Vancouver Station

In Vancouver the B. C. Electric is now erecting a substation covering the west end of the city, the residential and apartment house centre. This building will be 60 by 68 feet in size, one storey in height with an additional storey for the transmission gallery, and fireproof throughout. Structural steel with brick curtain walls and a concrete roof are being planned. The estimated expenditure on the station will be in the neighborhood of $100,000. Current will be fed to the building at 11,000 volts, transmission lines being arranged from the Vancouver sub-station as well as the Burnaby receiving station, thus affording an alternate base of supply in case of accident to either lines. The electrical equipment of the building will consist of two 1,000 kw. d.c. motor generator sets, consisting of 11,000 volt motors and 600 volt generators, this equipment regulating the current for the tram lines in the section and the d.c. current used by elevators in apartment houses. The station will also be equipped with one bank of three transformers of 7,500 kw. capacity for regulating the private and street lighting of the district.

Personals

Mr. E. S. Jefferies is electrical engineer of the Steel Company of Canada, Limited, Hamilton, Ont.

Mr. Alexander Shaw has been appointed chief claims agent and assistant secretary-treasurer of the Montreal Tramways Company.

Mr. George W. Thompson, superintendent of the light and power department of the City of Westmount, P.Q., has been appointed acting controller of the city.

Mr. Thomas Ahearn, president of the Ottawa Electric Railway Company, and Mr. James D. Fraser, secretary-treasurer, left on March 27th for a two weeks trip to Cuba, Jamaica and Panama.

Mr. F. D. Burpee, Superintendent the Ottawa Electric Railway Company, was married in Oswego, N.Y., on Easter Monday. The employees of the company presented Mr. Burpee with a comfortable and handsome arm chair as a wedding gift.

Mr. A. G. Sangster, formerly electrical superintendent of Saskatoon, will open an office in that city as consulting engineer on electrical and hydraulic work. Mr. Sangster has recently been retained by the town of Rosthern in connection with work there.

Mr. A. Kastella, chief engineer of the Grand Trunk power plant at Stratford, has been appointed chief engineer of the Grand Trunk Central station and Chateau Laurier at Ottawa. Mr. Kastella will have charge of the lighting, heating and equipment of the terminal and hotel.

New Vernon Plant in Operation

First Diesel Oil Engine Plant in British Columbia—Another Unit will be purchased at once

On Monday, February 24th, before a large interested gathering, Mrs. J. T. Mutrie wife of Mayor Mutrie, of Vernon, B. C., started up the new Diesel oil engine set. This unit has been locally named the "W. H. Smith, No. 1," in honor of Alderman Smith, chairman of the electric light department.

As this Diesel engine was the first of its kind to be installed in British Columbia the city council thought it only proper and right that its operation should be brought prominently before the citizens of Vernon and surrounding towns, and invitations were issued by the mayor and council to the members of the Board of Trade and ex-councillors of Vernon and to municipal officers of the neighboring municipalities, to attend the ceremony of christening and starting up the new engine at 4 p.m. Monday, February 24th. A general invitation was sent out to the Vernon citizens to inspect the unit at 8 p.m. the same evening.

Before the engine was started several prominent members of the city addressed the guests. It was pointed out that the load had increased by 50 per cent. during 1912 so that it would be necessary to prepare for a much larger load in the near future. The present capacity was stated to be 450 h.p. but there was a 600 h.p. load definitely in sight. Alderman Smith, chairman of the electric light department took occasion to speak on the new by-laws which were being placed before the people, asking for another Diesel unit of 500 h.p. capacity as well as extensive additions to the street lighting system. These by-laws have since been passed and call for the expenditure of $100,000 in the near future.

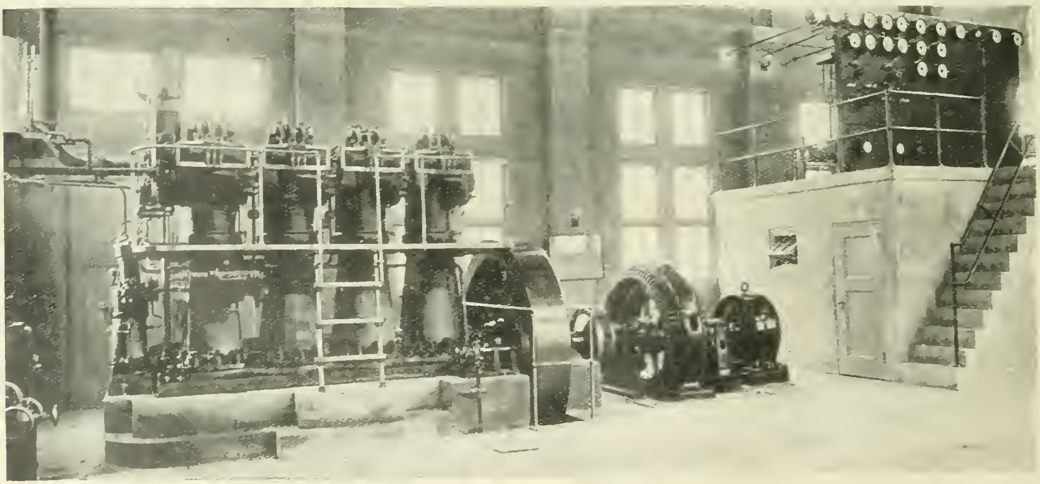
Up to the present the Vernon plant has consisted of a 14 in. x 36 in. Jenckes tandem compound condensing Corliss engine running at 92 r.p.m. belted to a 200 kw. Westinghouse type S. d.c. generator. Two Jenckes return tubular boilers of 105 h.p. each with Wainwright heater, supply the steam for this equipment. Comparative figures show that the fuel consumed during 1912, using cordwood at $6 a cord, cost $12,881, whereas if oil engines had been used it would only have cost $5,659. This saving of between $7,000 and $8,000 is a large item and when the second Diesel engine is installed (tenders are already called) it is proposed to let it take care of the interest and sinking fund of the money raised by debenture. As the money invested in this way will be revenue producing it is calculated that the second unit will, practically, not cost the citizens one cent.

With the old steam plant however, although the cost was $6 per cord for wood, the rate charged was lower than in any other steam operated plant in the province. In spite of this the plant produced sufficient revenue to meet the operating expenses, the yearly contribution to the sinking fund, the interest on the investment, allow a liberal amount of depreciation on equipment and still leave a fair margin of profit.

Exterior power house, Vernon, B. C.

The new plant is a 200 h.p. Mirrlees, Bickerton & Day, 4 cycle, 4 cylinder, single acting Diesel engine operating at 252 r.p.m. This engine was installed by the Canadian Boving Company of Toronto under the supervision of Mr. T. Steele. The generator is a direct connected, 156 kv.a. Westinghouse, 3-phase, 60 cycle, 2200 volt unit with a 10 kw. exciter unit, 110 to 140 volts, on the end of the generator shaft. The old steam plant will in future, operate in parallel with the new generator.

The Vernon plant was constructed under the direction of



Interior Vernon municipal oil-electric plant—Switchboard and office to right.

Mather, Yuill & Company, consulting engineers of Vancouver. During the erection of the reinforced concrete power house building this firm's own cement expert was present and tested every layer of concrete with a concrete testing machine. The electrical work was installed under the personal supervision of Mr. C. Yuill. All the wiring is suspended on iron racks in cement trenches with lead encased high tension cable. From the switchboard power and light circuits run underground, with lead cable run in loricated conduit, to the centre of distribution terminating at both ends in high tension pot heads. From the centre of distribution, which is central, three and single-phase light and power circuits will be run so that the voltage will have a minimum drop and be normal throughout the city. On the different circuits supplying power outside the city limits, pole type automatic regulators will be used and when the new construction is completed the distribution system will be first-class overhead construction. All poles will be painted and stepped, not less than 10 in. diameter at the small end, and the butts will be treated with some reliable compound.

The new Diesel unit has now been in operation running continuously for a week and is giving every satisfaction. The engine can be started up from rest in 60 seconds and only one man is required to start and attend it during running. The photographs herewith show the exterior of the power house and also the arrangement of the equipment in the power house with the superintendent's office surmounted by the switchboard on the right hand side of the picture. We reproduce these photographs through the courtesy of the Vernon Photo Company. Mr. R. B. C. Hammond is the superintendent of light and power in the city of Vernon.

One hundred feet from the power house two 5,000 gallon oil tanks purchased from The Robert Hamilton Company of Vancouver are installed below the ground level, from which point by a systematic arrangement of piping, the oil can be controlled almost at will, reducing labor and measurements to a minimum.

Switchboard

The switchboard is mounted on a concrete and steel gallery above the rheostat room and superintendent's office. This switchboard is of 5 panels and is equipped with all the usual standard instruments, together with wattmeters, power factor meters, synchroscope, frequency indicator, etc. The voltage is controlled by a Tirrill regulator. By a system of auxiliary d.c. bus-bars the two exciter generator sets can be run in parallel, singly, or either one excite both alternators. All outgoing feeder circuits run from a feeder panel with overhead time limit automatic oil circuit breakers, with relays connected to the three legs of each circuit.

Power House

The power house building is of steel reinforced concrete construction 50 ft. x 38 ft. 33½ ft. high. Roof is of fir, dressed on four sides laid on edge lengthwise, and nailed together with 6 in. steel wire nails spaced two feet apart. These rest on steel trusses, with a covering of one-quarter inch hair felt, completed with a layer of Johns Manville Asbestos roofing. The walls and pilasters, both inside and out, are neatly finished off with a cement plaster containing an approved waterproofing agent, finally finished up with a wash of neat cement. Below the switchboard gallery is a spacious room for the superintendent's office, rheostat room, and bathroom containing white enamel bath, toilet and wash basin, for the use of the engineers when coming off duty. After the installation of the 500 h.p. oil engine this coming fall, the floors will be tiled and the walls painted. Underwriters' doors and windows are used throughout, making the building fireproof in every detail. All the interior wiring is run in loricated conduit which was imbedded in the concrete during erection.

Light and Power

The street lighting system consists of 72-7½ amp. enclosed arcs, and 80-100 watt series tungsten lamps. Plans for the erection of ornamental cluster light standards for the principal avenues are now being made.

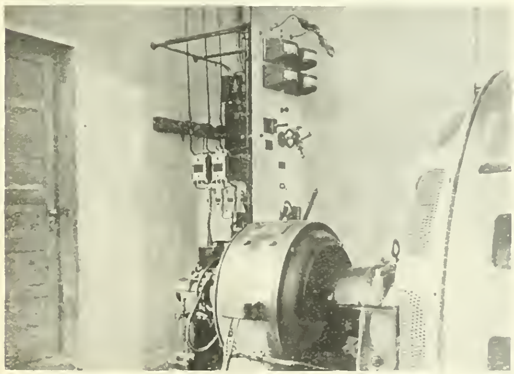
The power rates are—a definite fixed charge of $1 per h.p. per month of maximum demand, to be determined by watt meter tests at least every six months, under maximum working conditions of the motor, and, in addition to the fixed charge, the actual energy consumed to be charged for at these rates:—First 100 kw. hours at 05c per kw. hour; 101 to 200 kw. hours at 04c per kw. hour; 201 to 500 kw. hours at 03½c per kw. hour; 501 to 1000 kw. hours at 03c per kw hour; 1001 to 2000 kw. hours at 02½c per kw. hour; 2001 kw.h. and over at 02c per kw.hour; all less 10 per cent. if paid within 10 days.

The light rates are—10c per kw. hour, less 20 per cent. if paid within 10 days, which is practically 8c. Maximum charge $1.25 per month including meter rent. Power rates are granted to consumers using electrically operated domestic conveniences, when a separate circuit and meter is installed.

A Neat Saskatchewan Plant

Canora also instals a Gas-Electric Unit—Local Isolated Plants closing down—Modern Street Lights.

Within the past two months there has been completed at Canora, Sask., the installation of an electric light plant. The increasing demand of towns in the west for the comforts of civilization, added to the keen competition between the various municipalities has caused and is causing great struggles for civic improvements in order to attract settlers, manufacturers and merchants, etc., to find better attractions in one particular town than any other. Almost the first improvement of any importance is the introduction of electric lighting, and often in small towns hotel keepers have found

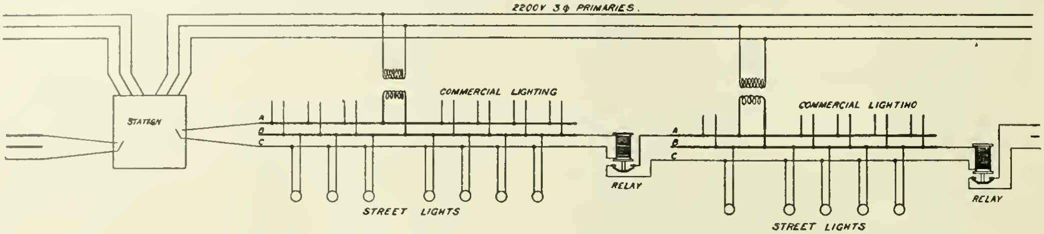


Switchboard, exciter and generator, Canora.

it a necessary commodity and have therefore installed small battery sets. (In this town the two biggest hotels had plants of their own but as would be expected they are now connected to the municipal plant). It is then to be anticipated that great strides will be made in the number of municipal plants in the near future owing to the rapidity with which the population of the west is increasing and highly important that the

people get competent engineers to advise them as to the best system to adopt for their individual cases and so prevent the various municipalities from entering into an unprofitable undertaking.

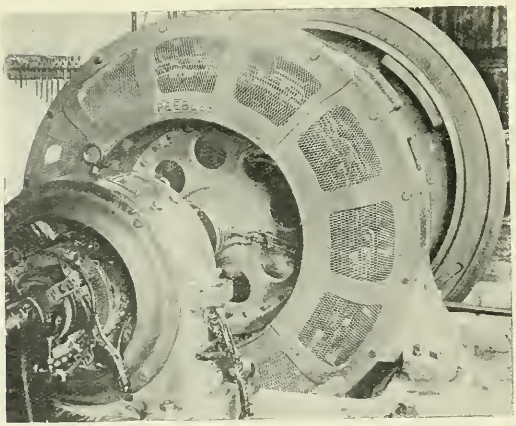
The town of Canora recognizing that they had reached a point at which they would benefit by the addition of an electric light plant, employed the services of consulting engineers to prepare reports on systems using as prime movers (1) steam engine; (2) gas engine; (3) oil engine; the engineers being instructed to take into account the capital expenditure, maintenance costs, depreciation, etc., of each system. The engineers appointed were Messrs. Bowring & Logan, of Winnipeg, and acting under their advice the council decided to install a crude oil engine of the Diesel type as prime mover. The low cost of crude oil, low standing charges of the plant, the easy operation, and reliability of this engine, entered into consideration in deciding upon installing the installation of this prime mover.



Plan showing distribution system adopted for Canora's street lighting.

The town having decided on going ahead with the work, also determined that no reasonable expense should be spared. The complete plant includes a new building, engine, generator and exciter, switchboard and auxiliary apparatus and a pole line.

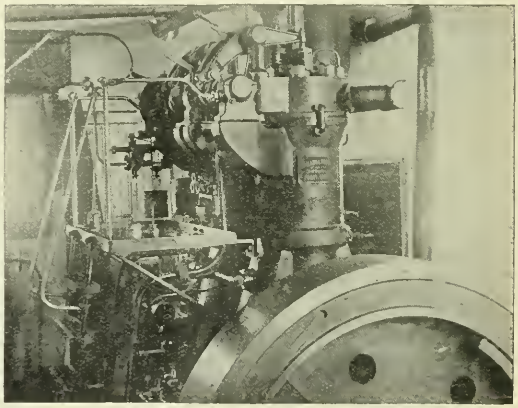
The building includes (1) space for a pressure system of fire protection already installed; (2) Fire Hall for hose reels and chemical fire engine; (3) room for firemen's quarters; (4) hose drying tower, and (5) space for future unit (to be used for municipal offices temporarily). In few towns would a building be found which would present such a handsome and solid appearance, its construction being practically fireproof. The walls are of red brick and the roof is covered with Rubberoid Roofing. Owing to the close proximity of a well of 25 feet diameter to one wall of the building, the whole of this wall is carried on a reinforced concrete beam supported at four points on solidly built piers. The maximum span between two piers is 20 ft. and 1¼ in. round steel was used for reinforcing. The nature of the ground and the presence of a layer of quicksand made it of the utmost importance that great care be taken to insure good foundations and good footings. The latter being placed on blue clay.



End view showing exciter and generator.

The engine, generator and exciter was purchased from the Northwestern Electric Company, of Regina, Sask. It is a direct connected set of compact and neat design, made up of a Willans two cylinder Diesel engine, Bruce Peebles generator and exciter rated as follows:—engine 100 h.p., 240 r.p.m.; generator 63 kw., 2200 volts, 3-phase, 60 cycle, 240 r.p.m.; exciter 30-80 volts, 20 amps., 240 r.p.m.

The engine is connected to a filter which is in turn connected to a 200 gal. reservoir situate in the building, and thence through a hand pump to the main reservoir outside the building. The oil is fed by gravity from the 200 gal. tank to the filter and then to the engine. A small quantity of coal oil is kept in a separate compartment of the filter and used for starting purposes and also for about five minutes before shutting down the engine. This is not absolutely necessary, but is advisable in order to clean the cylinders.



Engine and large fly wheel, Canora, Sask.

To most readers the operation of a Diesel engine is well-known, but as the machine is likely to be of importance in generating plants of the future it may be well to give a brief description of it. The engine is a four cycle engine and is nearer to the ideal Carnot cycle than any type known. On the first down stroke air is drawn into the cylinder and during the second stroke the air is subjected to compression

of a very high degree and is therefore heated to a high temperature. On the third stroke, immediately after the piston has started in the downward direction, crude oil is sprayed in and is evaporated and ignited by the high temperature of the compressed air and not by any other means. The fourth stroke of the engine is upward and the burnt gases are exhausted. It is therefore apparent that in a two cylinder engine there is one explosion to every revolution. In order to force the crude oil into the cylinder a small compressor, mounted on the main shaft of the engine is used and the pressure is so regulated as to be well above the cylinder compression thereby enabling the oil to be forced into the cylinder. This compressor is also used for pumping air into reservoirs, which air is used for starting purposes at a pressure of about 65 to 75 atmospheres.

The tests carried out at the completion of the installation speak well for the quality of the apparatus and is highly creditable to the manufacturers. The figures given below show well the low running costs as regards fuel as crude oil is bought at 13c a gallon F.O.B. Canora. They also show that the actual consumption comes well within the guaranteed figures.

Consumption in lbs. of Oil per B.h.p.

	Actual	Guaranteed
Full load per B.h.p.	.468	.494
Ten per cent. overload per B.h.p. .	.471	...
Half load per B.h.p.	.565	.599

Tests were also carried out on speed regulation and the governor worked in a highly satisfactory manner. The usual tests were made on the generator and exciter and the figures obtained were well within the guarantees.

The distribution system adopted was one which has been proved satisfactory in some eastern towns and is giving every satisfaction in Canora. The accompanying sketch, Fig. 1, shows the method adopted. The solenoid switches were supplied by the Electrical Repairs & Maintenance Company.

The street lighting has been highly commended by all who have seen it, and makes a bright and attractive town where before at nights the streets were all darkness. The main street is lit in the down-town section by lights on both sides of the street. These lights are placed on poles 90 yards apart, two lights of 60 watts each being located on each pole, one over the sidewalk and one over the road. The upper portion of the main street is similarly lighted but the poles are on one side of the street only. The side streets are lit with 100 watt lamps placed about 150 yards apart. All the lights are placed at least 13 ft. 6 in. above the ground and give a really good and efficient illumination.

The work from start to finish was carried out at Canora under the direction of Mr. G. H. Stevens, who was employed as resident engineer for the work. It speaks well for both Mr. Stevens and his employers that since the starting up of the plant, there has not been the slightest hitch in its running nor any shut down.

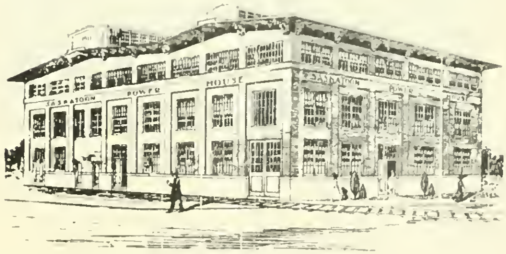
In addition to equipment already mentioned, other orders for various supplies were placed as follows:—meters, Chamberlain & Hookham Meter Company; transformers, Packard Electric Company; line material, Northern Electric & Manufacturing Company; switchboard, Can. General Electric Co.

The Western Canada Power Company, Vancouver, whose contract with the British Columbia Electric Railway for the supply of power was announced some time ago, have placed the contract for two 13,000 h.p. double Francis turbines with Messrs. Escher Wyss & Company, Montreal; these units to be installed at an early date. The same company will supply two inlet drum gates. The dam at Stave Falls will be raised to elevation 240 feet so as to create additional storage capacity in the Stave River and the Stave Lake.

Saskatoon's Steam Plant

New Power House—3500 Kilowatts in Generator Capacity—Fully Equipped Boiler Room

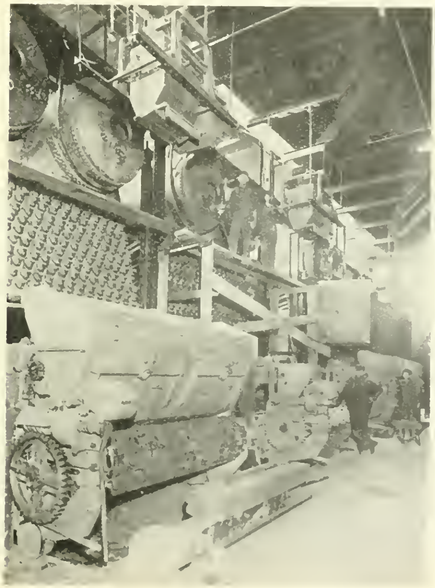
The illustrations herewith show typical views of Saskatoon's new power house and power generating equipment. The capacity of the generating equipment is now approximately 3500 kilowatts. This is contained in a new brick and steel power house 150 ft. by 80 ft. 40 ft. in height, which the



Saskatoon Municipal Power House.

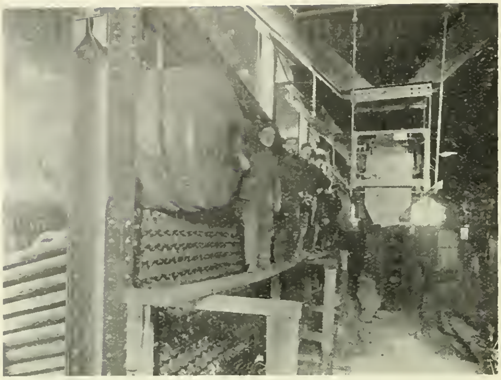
city has just completed. The power house is divided into two parts by a brick partition, one part 100 ft. by 80 ft. for the boilers, and the other part 50 ft. by 80 ft. for the engines and generators. Underneath the engine and generating room is a 10-ft. basement for condensers, conductors, etc. A 10-ton travelling crane is installed overhead.

The equipment at present installed is as follows: one

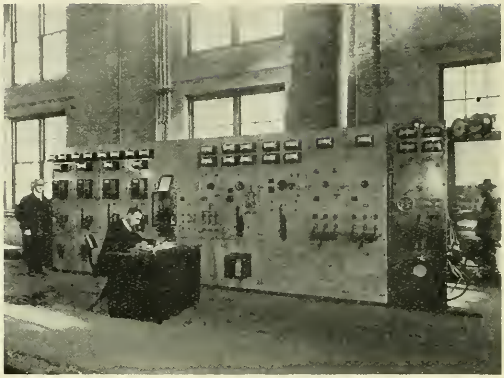


Interior View Saskatoon Power House.

2000-kw., 2300 volt, 2-phase, 60 cycle, 18 r.p.m. generator direct-connected to a reactive type, 3-stage Parsons steam turbine with an overload capacity of 25 per cent. for twenty four hours, supplied by the Allis-Chalmers Company of Milwaukee; one 937 kv.a., 2300 volt, 2-phase, 60 cycle, 150 r.p.m.



Engine room during construction, Saskatoon.



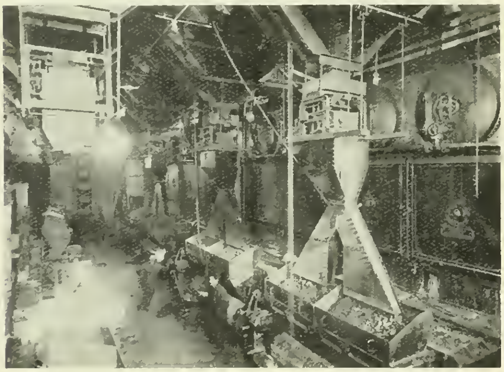
Main switchboard, twelve panels, Saskatoon.

C.G.E. generator direct-connected to a Robb vertical cross-compound engine and one 500 kw., 2300 volt, 2-phase, 60 cycle, 150 r.p.m. Allis-Chalmers-Bullock generator direct-connected to a Robb cross-compound engine. The exciters are two 75-kw., 125 volt, 2400 r.p.m. Allis-Chalmers type direct-connected to Parsons steam turbines, and one 40-kw., 125 volt, 300 r.p.m. C.G.E. type direct-connected to a Robb engine.

The street railway is served by two 300-kw., 600 volt, 600 r.p.m direct current generators, direct-connected to two 2300 volt, 3-phase, 60 cycle synchronous motors.

The main switchboard shown herewith consists of twelve panels as follows, from left to right of the figure; four feeder panels; one panel for Tyrrill regulator; one blank exciter regulator; one panel for 40 kw. exciter; one panel for 937 kv.a. generator; one panel for 2000 kw. generator; two panels for the 75 kw. exciters; one panel for a curve drawing wattmeter.

The street railway switchboard has five panels as follows: one feeder panel, two direct current generator panels and two alternating current synchronous motor panels.



Equipped with automatic control, Saskatoon.

The main streets in Saskatoon are lighted by tungsten in five-light ornamental standards, but the outlying streets are supplied with arc equipment. These include two 50-light, 6.6 amp. magnetite sets and two 25-light, 6.6 amp. sets with a.c. series lamps.

The boiler room equipment consists of eight 500 h.p. Babcock & Wilcox boilers equipped with travelling grates, steam superheaters and Green fuel economizers. The coal is elevated from a bin beneath the railway cars by an endless belt to a coal bunker of 600 tons capacity situated over the boilers. From this point it feeds down to the hoppers of the travelling grates. Each boiler is equipped with an automatic coal weighing machine. There is also supplied a motor-driven ash conveyor to carry ashes away from the boilers as soon as they are dumped from the travelling grates. The coal and ashes are all handled automatically from the time the coal leaves the bins beneath the cars till the ashes are dumped outside the car house to be carted away. A forced draft is furnished by two motor-driven fans. There are also two engine-driven fans as auxiliaries.

The power house also contains two condenser pumps of 840 gallons capacity per minute under 40 ft. head driven by two 220 volt, 10 h.p. motors and two condenser pumps of 3500 gallon capacity under a 40 ft. head driven by two 220 volt, 25 h.p. motors.

The power house staff for each of the three shifts of eight hours includes one switchboard operator, one engineer, two oilers, one fireman. The cost of generating figures out at 2¼c per kw. hour at the switchboard. Soft coal costs $7 per ton F.O.B. the power house.

With the exception of a few run-offs the street railway was put into operation without a hitch and is proving very successful. The system in the near future will be extended to the town of Sutherland, two miles from the city. Sutherland has offered to build the line if the city will operate cars over it.

Waneta Development Company

According to a recent announcement made by Mr. David Walmsley, of Nelson, B.C., one of the directors of the Waneta Development Company, upwards of $75,000 will shortly be expended by the company on its proposed power plant at the junction of the Salmon and Pend d'Oreille rivers near Waneta, under a bond of $10,000 which has been deposited with the provincial government as a guarantee of good faith. It is understood that the plant will be of an initial 2500 horse-power development, and so constructed as to permit of future extensions. The plans of the company also include the construction of a power line to Sheep Creek, to supply the mines in that district, and possibly later an extension to Salmo. The project is backed by capital from the United States, but was originally mooted by the Pacific Exploration Company some years ago.

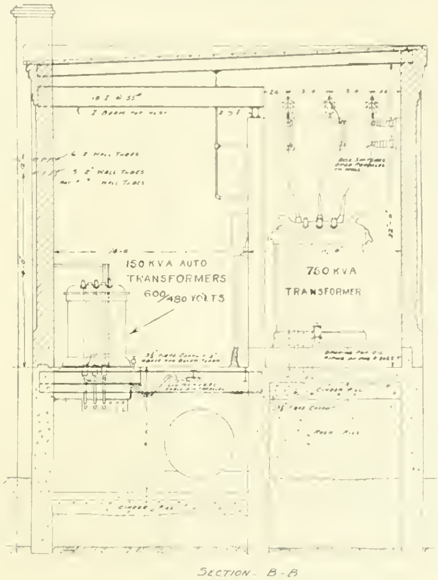
A Well Designed Sub-station

On the Electric Power Company's Line to Serve the Canada Cement Company, Belleville

Owing to recent extensions and improvements in the Canada Cement Company's Belleville mill, they will require additional electric power to operate. For the past year and a half this mill has been driven electrically by power furnished by the Electric Power Company. About 1200 h.p. has been used, this being furnished through a sub-station stepping down from 44,000 to 480 volts, and located on the cement company's property. The sub-station as originally constructed contained 2-750 kv.a., 60-cycle, 3-phase, water-cooled transformers, ratio 44,000 to 600 volts, together with 2-750 kv.a., 3-phase auto-transformers, ratio 600 to 400 volts. This allows of the use of standard 750 kv.a., 3-phase transformers, as adopted by the Electric Power Company, there being now 18 similar transformers of this particular size on the system. These transformers have been furnished by the Canadian General Electric Company. The high tension windings are arranged for 44,000 volts, with taps for 42,000 40,000 and 38,000 volts. The low tension windings are arranged so as to be interchangeable for 600 and 2,400 volts, so as to feed directly to large mills or factories, using 550 volt motors, or into local distribution systems using 2,200 volt service transformers. For either the 600 volt or the 2,400 volt connection the low tension windings are delta connected. The 2,400 volt windings can be "Y" connected, and the neutral brought out, thus giving 4,160 volts, 4-wire, 3-phase, which method of distribution is already in use from several of the Electric Power Company's sub-stations, in the vicinity of which the load is sufficiently scattered to warrant the higher voltage for distribution.

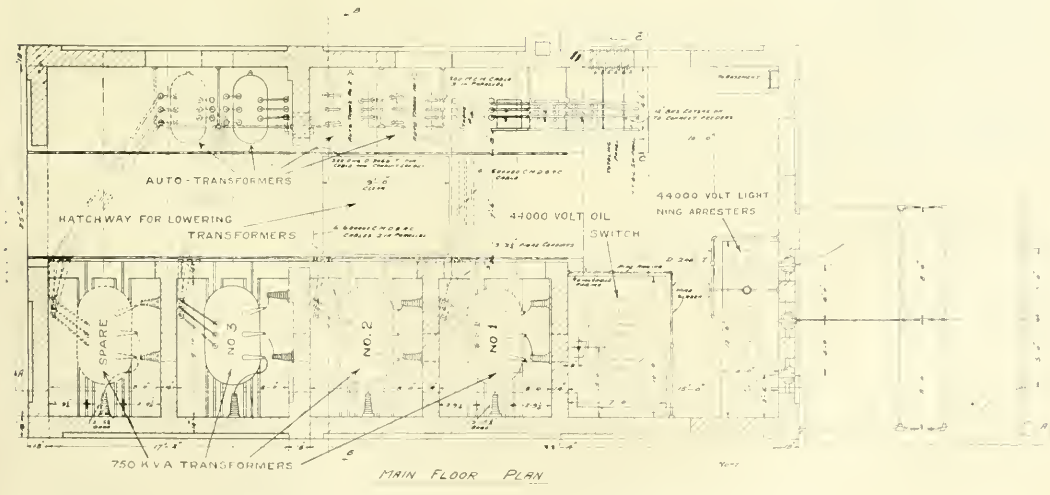
The 4,160 volt, 3-phase, 4-wire system has some very distinct advantages for such work, in that it allows of the distribution of power, with a cost for distributing copper of hardly more than one-third the amount required for a 3-phase, 3-wire, 2,400 volt system, while at the same time standard light and power transformers wound for a primary voltage of 2,200 volts can be used, one side of the transformer being connected to the neutral. The radius of distribution from each sub-station is increased to such an extent that a smaller number of sub-stations are required on the system.

The auto-transformers for stepping down from 600 to 480 volts are considerably smaller and of lower cost than double winding transformers, and it was considered advisable to use them to supply power to the 440 volt motors in the cement mill rather than build special transformers to step

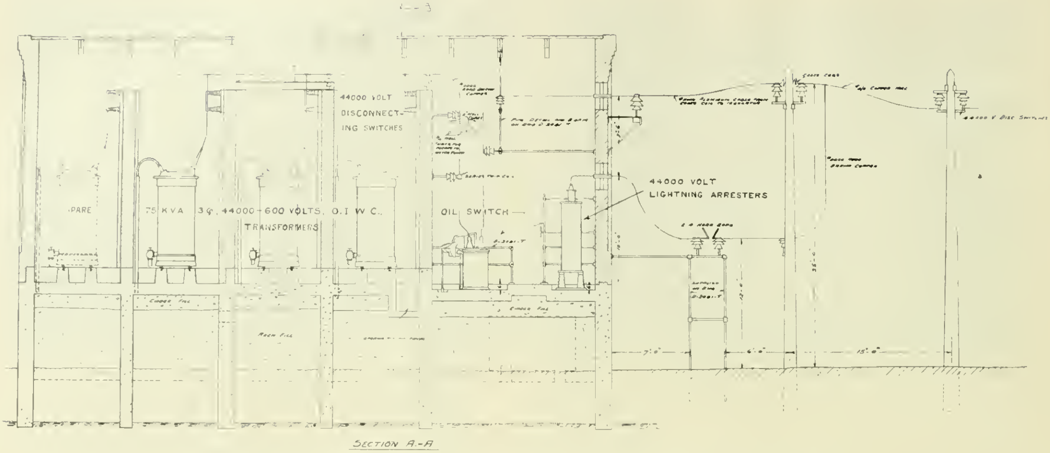


Section Belleville cement sub-station

down from 44,000 volts to the motor voltage. The power demand at this mill has recently been considerably increased, so that it has been necessary to build an addition to the sub-station and install a third 750 kv.a. transformer and an auto-transformer. The extensions to the sub-stations have been made in such a way that space is left for a fourth transformer, if such becomes necessary. The sub-station is also built in such a way that extensions can be made indefinitely



Main floor plan Belleville sub-station of the Electric Power Company



Vertical cross-section Belleville sub-station, to serve the Canada Cement Company

for the installation of additional transformers. The building is of simple rectangular type, see drawings herewith, and in addition to the transformers and low tension switching equipment, it contains a 44,000 volt oil circuit breaker and an electrolytic lightning arrester, the horn gap and choke coils for which are mounted outside of the station. In order to dismantle a transformer for repairs it is lowered through a hatchway to the cellar, thus decreasing considerably the head room required in the station. An oil tank and oil pump are located in the basement, and will take care of transformer oil during erection or repairs. The load now carried by this sub-station is in the neighborhood of 2,000 h.p., and as usual with cement mill loads, the load factor is exceedingly high, as the mill operates 24 hours a day with fairly constant load. Pits are arranged below the transformers, so that in case of an escape of oil from any transformer it will be entirely confined to the pit of the transformer, from which it escapes. A good supply of water for cooling transformers was not readily available, therefore a wooden tank lined with galvanized iron and set of cooling trays was erected next to the sub-station. This, together with a 1½ in. motor driven turbine pump, provides cooling water for the transformers. A transformer transfer truck running on rails on the main floor of the station provides for the moving of the transformers.

Power Situation in Lethbridge

Valuable Report on the Relative Merits of Water Power, Gas Firing, Gas Engines and Coal

The report by Mr. R. A. Ross, consulting engineer, Montreal, on the power situation in Lethbridge, is valuable in its discussion of the relative merits of different forms of prime movers, applicable to that section of the country. Mr. Ross reported as follows:

The existing power conditions in the City of Lethbridge are, briefly, as follows:—population, 12,000; boiler horsepower, 2,280; generating equipment, 2,438 kw.; maximum peak for 1912, 1,000 kw.; night load, 200 kw.; daily load factor average per year, 30 to 32 per cent.; total customers, 1,500; cost of coal from municipal mine, $1.65; heat value of coal, B.T.U., 9,500; capital cost per kw. of station, including buildings, $128.

Looking over the station I found a first-class equipment, situated at the mouth of a mine producing a fair grade of coal, the whole indicating a plant from which the best economy should be expected, the only matter which would tend to reduce its inherent efficiency being the small amount of load carried as compared with the capacity of the plant. The surplus capacity at present unused is given by the 1,500 kw. turbine which has recently been added in anticipation of future growth, and although at the present time the equipment is largely in excess of present demands. I cannot but feel that the size of turbine unit adopted was wise in view of probable growth. The situation, therefore, is that at the present moment the production costs are burdened with the charges on the additional equipment necessary to provide for future growth, but which is not at the present time fully utilized.

Water Power

It has been suggested that power might be derived from the Belly River, at a point some distance from the present power station, where it is claimed that a damsite is possible.

In dealing with this question the records of the government show that the flow of the Belly River at the point falls as low as 120 feet per second. If, however, we consider a total of 200 feet as available and the possibility of obtaining a 50-foot head, which I understood is as high as can possibly be got, the total derived will only be 830 horse-power. What the conditions are during winter we do not know from government reports, as no records are taken, but the probability is that the flow is very low, indeed, at the time when your power requirements are greatest. It would appear, therefore, that in view of the cost and uncertainty of power obtained by the construction of an expensive dam across the river, it is not within the bounds of commercial possibility.

Gas Firing for Boilers

I understand that the price of 10,500 b.t.u. gas at Lethbridge is 15 cents per 1,000. For the purpose of boiler firing this is equivalent to 9,500 b.t.u. coal at 3.80. It will therefore be seen that there would be no advantage in using gas for this purpose when your coal only costs $1.65 per ton. If gas were adopted your investment in coal mine, bunkers, conveying machinery and stokers would be thrown away, and an additional investment of $500.00 per boiler would have to be made for gas-firing equipment, and little would be saved in the way of labor, as your coal is handled and fired by machinery at present.

Gas Engines

Consideration might be given to gas engines, provided

your equipment were not already installed, and this purely on the basis of saving of fuel, as the capital cost of the gas engine equipment will be about the same as that of your present station per horse-power.

From some rough figures I have made it appears that under condition of a new plant being established, gas engines might be a serious competitor to your present equipment, even with coal at the low price which you pay, and it may be that improvements in gas engines or the development of the gas turbine may make it possible for you to make extensions in later years with gas engines, but, at the present time and under existing conditions, until your load has increased sufficiently to warrant additions, the gas engine equipment appears to be unacceptable.

Transmitted Power

It has been suggested that power could be generated at one of the coal mines adjacent to Lethbridge from slack coal, and transmitted to the city, at a cost to you less than you are generating at present, or may in future.

The only possible condition under which this seems probable would be that the coal mine had a very large equipment or electrical machinery for its own use, and really sold you the surplus power generated. It must not be forgotten in this connection that the only saving would be the coal, as in order to obtain the same results which you should obtain with your plant, the company would have to install apparatus of equal efficiency, which would cost as much to them as to you, viz., about $128 per kilowatt; in addition, they would have to provide a transmission line, possibly seven or eight miles long, over which the power would have to be transmitted at 6,600 or 12,000 volts, and a stepdown station and switching equipment provided by them to reduce to 2,200 volts for use in Lethbridge.

This would mean that their total capital investment would be higher than yours, and it would seem entirely probable that with the small amount of power used at present in Lethbridge and the low factor which you have that the saving in fuel, if it cost nothing at the mouth of the mine, would be eaten up by fixed charges for line and transformer equipment and their necessary attendance, repairs, etc.

However, of the bare possibility that a less rate might be obtained from the source than it is costing you at present, it might be advisable to enter into negotiations with these companies, sending them a maximum load curve of your station for last year and also a minimum summer load curve, explaining that power should be delivered to you at 2,300 volts on your switchboard at Lethbridge to render a comparison possible, and intimating that the loads from your past experience might be expected to increase at a certain rate per year.

Suggested Procedure

As will be seen by the above, I am of the opinion that with the equipment at present installed, and the fact that coal can be had cheaply, practically at the door of the power house, it is very improbable at the present time that you can devise any other means of obtaining power as cheaply as with your present equipment, but that the best results in your plant will not be obtained until your loads are very largely increased.

I submit herewith a load diagram corresponding roughly to your demand during December of last year. On this diagram I have cross-hatched the area representing the output during peak load of the year, and have also indicated the safe capacity of the plant—in other words, the load in kilowatts which you could safely sell, considering that if one or other of your small engines is broken down, the remaining equipment can be operated, as it easily may be, for a short time at 25 per cent. overload. From the figures on this diagram you will see that the output of your plant in kilowatt hours, at 30 per cent. load factor, is only 13.6 per cent. of the total which might be possible under a 100 per cent. load factor. You have, therefore, represented in the large unhatched space the possible additional output, and while it is not possible to obtain this load factor under practical conditions, there is evidently a large field for the sale of additional power without any increase in your plant for some time.

I would therefore strongly suggest that all possible means be adopted to increase your load factor, and to fill up the hollows in the curve by pushing the sales of electrical devices and the sale of power off-peak. This is a commercial condition which confronts every electrical manager, and, generally speaking, the question whether dividends are paid or not depends upon his ability in utilizing to the fullest extent the possible output of the plant by the sale of power when it is not in demand at the peak of the load for lighting.

We understand your greatest desire is to encourage the establishment of industries in Lethbridge, the object being the attainment of population. I would point out in this connection that smaller manufacturers, where a large number of men are employed and a smaller amount of power used, are of more importance than the larger industries, where more power is used and fewer men engaged.

At the present time you will note that you might sell an additional 1,200 kw. over 24 hours per day without encroaching on your peak and also an additional amount of off-peak power represented by the un-hatched portions below the 1,000 kilowatt line. The cost of this power, if it could be sold, would be only the cost of coal, the question of fixed charges on additional plant not having to be met, and, owing to the fact that your boilers are mechanically fired and the coal is also handled in the same way, your labor charges would be increased but slightly, if at all.

Under these conditions, with your economical plant loaded up to its full capacity and, therefore, consuming only about half the coal per horse power, at present, you could generate this excess power for 24 hours per day and 365 days in the year for about $22 per horse power year, and for 70 hours per week and 52 weeks in the year $10 per horse power year at your power house terminals, with coal at $1.65 per ton.

It must be remembered, however, in this connection, that if this be done and power be sold over the peak of the load that you will have to later increase your plant to take future peaks and will, in effect, therefore, in future be saddling all the fixed charges of your entire plant on the peak load, from the charges which they are entitled to share with others. If, however, you sell your additional capacity to power consumers, whose power will not appear on the peak of your load, the extra cost involved is practically only the cost of coal as above, and no criticism can arise on the point of fixed charges not being properly placed.

Summing Up

Summing up the above, it appears that:

(1) You have a modern equipment fully capable of dealing with your demands for some time.

(2) That the amount of power derivable from the Belly River is too small and uncertain and expensive for your purposes.

(3) That gas firing of your boilers will be more expensive than coal at present prices.

(4) That the possibility of gas engine use lies in the future, when your present plant requires extensions.

(5) That in view of possibilities it might be well to obtain tenders upon power delivered from a coal mine.

(6) That as you have by no means developed the possibilities of the plant you have, attention should be concentrated on obtaining a greater load, especially of off-peak power, for which very low rates should be given.

Electric Hoists in Mining Operations

Many Applications of Electricity to Mines—The Use of Hoists Becoming General—Three Main Systems Explained

By Mr. C. H. Wright

Mining engineers have long recognized that electric drive and distribution affords advantages superior to all other systems. For lighting, pumping, and surface operations there have been a large number of electrical applications. In coal mines, however, the largest motors would be those driving the electric hoists, but electric coal hoisting on any large scale has only recently come into use in this country. Steam hoisting is much more common even in those mines where electric motors are used for almost any other class of work. There are a number of mines using electric motors for conveyors, fans and pumps that have until recently been using compressed air for haulage, or a motor on the surface with an endless haulage system. Electric hoists show a saving because the steam generating plant may be centralized and high pressure steam may be produced with an economy that could not be thought of in numerous small boiler plants which would operate on fluctuating loads with lower pressure and without superheat; these small plants could not use advantageously modern methods of stoking, coal handling, and improved combustion. By combining these smaller stations high pressure steam can be used with superheat and low vacuum suitable for a turbo generator of large size; their load then becomes more even and of a size suited to this large equipment; whereas, in the case of numerous small steam hoist stations a large reserve is necessary at each station—the loads fluctuate, lower pressure and poor vacuum are encountered, all of which tend to poor economy.

An electric power, due to its rotary motion, has splendid torque characteristics. The power is uniformly applied throughout the operating cycle as there are no reciprocating motions or intervening connecting rods or cranks with varying torque in each position. The power demand is limited to the time during which the hoist is in actual operation. This minimizes the actual power consumption and under some conditions power may be returned to the line from the descending cars. This calls for a design specially suited to the conditions. In steam hoisting care is necessary when starting after a long stop to avoid cracking the cylinders due to uneven expansion and to water accumulating in the cylinder. Where electric hoisting is adopted exhaust steam can be used in the turbo generators—this exhaust being sometimes otherwise wasted. Where such conditions demand, electric hoist dimensions can be made very small indeed. The flexibility of control is obvious, and the cost of attendance is lower.

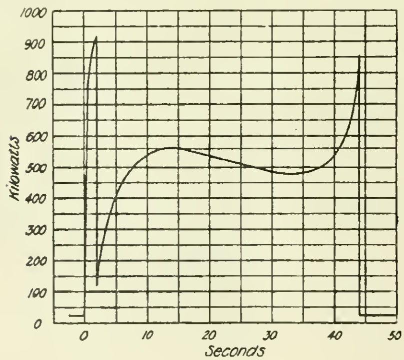


Fig. 1

For long distance transmission alternating current is generally used, and this may be applied directly to the hoisting drum through an induction motor. This induction motor may be either of the line voltage, or as is usually the case, of a lower voltage obtained through step-down transformers. Where better speed control is required, or where a direct current circuit is available, a direct current motor is sometimes preferred to the induction motor. Very efficient and refined speed control can be obtained from such an equipment. The induction motor is a simpler and more rugged device but does not lend itself so readily to varying speeds.

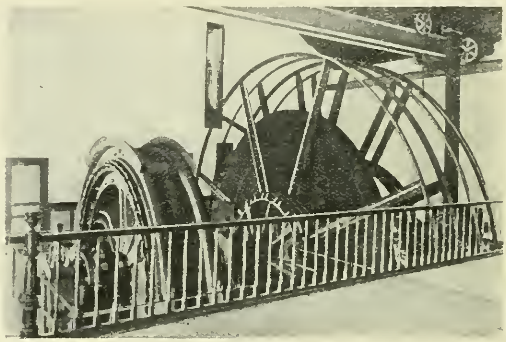


Fig. 2

It sometimes happens that on account of water conditions it is impossible to use pumps to unwater the mines, and a water hoist is sometimes used with a balanced bucket system, the buckets rising and falling, one emptying while the other fills. Such a bucket system overcomes trouble with acid or gritty water, but has a varying power demand. Fig. 1 shows the current consumption for one complete operation when the bucket is lifted, stopped and discharged. A steam hoisting proposition would not meet the requirements of such a case satisfactorily, but the electric drive is very satisfactory indeed. Occasionally buckets are raised and lowered by ordinary variable speed induction motors with rheostat control on the secondary; such motor would be geared to the cable drum, the entire equipment reversing to raise and lower the buckets. The more satisfactory arrangement, however, is to use a direct current motor, and if direct current is not available, then a motor-generator set is necessary to give the required power. If to the motor-generator set there is added a fly-wheel, the whole system has an inertia which makes for good regulation. Separate exciters should be provided, and the speed variation of the motor is obtained by field control of the generator. Such water hoists are in operation calling for powers over 800 horse-power. In order to obtain alternating current a synchronous motor-generator set is sometimes used and such an equipment may be designed to improve the power factor of the whole system, which with varying low loads often needs correction.

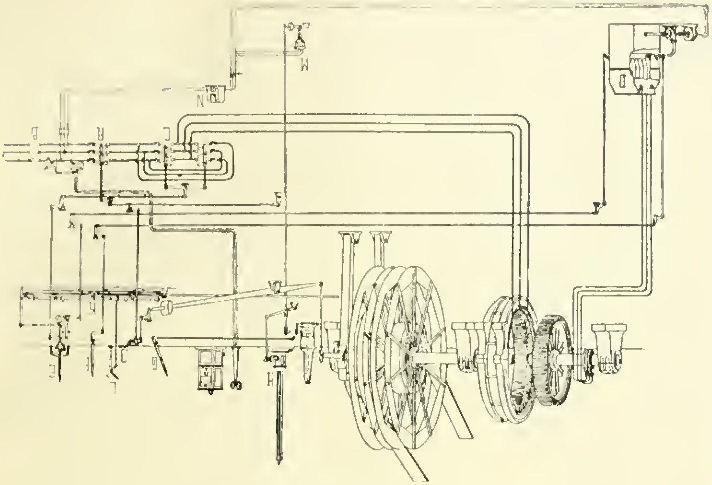


Fig. 3

The question of coal hoisting by electricity is a more serious problem but it has been faced in a number of our Canadian collieries. The Dominion Coal Co. is definitely committed to electric hoisting, having installed one such hoist, and having two more hoists on order. The Acadia Coal Company, Stellarton, Nova Scotia, have been using electric coal hoists for over a year.

There are three main systems of electric hoisting—(1) A phase wound alternating current motor taking comparatively high voltage current from the line or through transformers may be used; such motor would have rheostat control in the secondary using either liquid resistance or metal rheostat. If this motor were mounted directly on the drum shaft, it would be of low speed, and hence of comparatively low power factor and efficiency. Generally such motors are geared to improve the above conditions. An efficient Citreon gearing is sometimes used, and being accurately cut it brings the entire equipment up to normal efficiency. Rheostat control is not as economical as d.c. field control under many conditions. It may be the means of considerable loss if there are frequent starts. If the acceleration period is short as compared with the normal running period the case is different. This type of winding equipment is one of the best. A three-phase winding motor direct connected to the drum is shown in Fig. 2, and the diagram of connections for such an equipment is shown in Fig. 3. It is to be noted that such an equipment does not call for any motor-generator set or direct current apparatus; the expenses for winding equipment is, therefore, reduced to a minimum. The Dominion Coal Company, Glace Bay, will shortly install large winding plants driven by a.c. motors; and the Acadia Coal Company, Stellarton, are already using them.

(2) A second system of hoisting consists of a direct current motor mounted on the winding drum shaft and supplied with current from a motor-generator set which would take a.c. current at line voltage and deliver it to the winding motor at a pressure best suited to the design. Such a motor would have speed control by field variation using the Ward-Leonard system as in the case of the water hoist already described. This gives a more efficient method of speed variation. It defers the peak-load as desired within limits, and so eases the power house. A given position of the speed control lever indicates the certain speed of the rope, and under some conditions power may be returned to the line by the empty descending cars.

This a.c., d.c. equipment is more complicated and more expensive than the straight induction motor equipment but is much used in Europe and South Africa. A fly-wheel motor-generator set operates at practically a constant speed, and the fields of the generator are varied in strength by means of proper appliances; this gives a varying voltage to apply

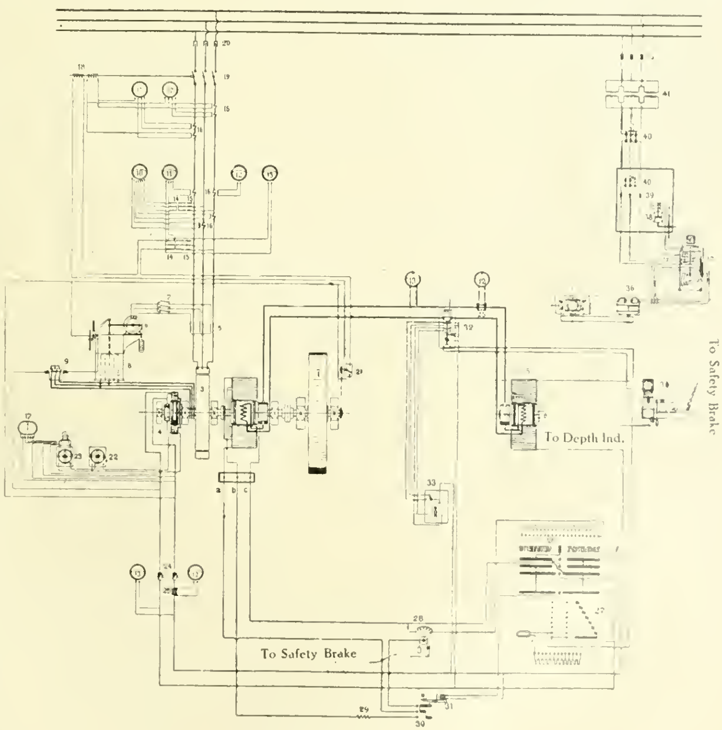


Fig. 4

to the winding motor. The finest of speed control is thereby obtained in the most efficient possible manner. A diagram of connections of such a system is shown in Fig. 4.

(3) The last system described is sometimes used without the fly-wheel effect, and the choice between these two is determined by the frequency and length of the acceleration period.

In some of our Canadian collieries motors of as high as 1600 h.p. are used in this class of work. Hoisting equipments of smaller power are comparatively common in the coal mining districts of Nova Scotia.

It might be of interest to add that practically all of the mining operations requiring power have had electrical applications in Canada. It is quite certain that these applications will be extended and developed in the near future. As regards such applications it is also pleasing to note that Canada is well in the fore-front of electrical developments.

A 900-Mile Telephone Talk

The Austrian telegraph administration recently decided to establish a telephone line connecting Vienna with Dalmatia. The line from Vienna follows a southerly course and passes over a number of islands in the Adriatic Sea to the coast of Dalmatia. The line therefore consists of both aerial and cable. The aerial line is of bronze wire, five mm. in diameter. The cable connecting the mainland and the islands has a total length of 60 km. (38 miles).

Considering the great distance between the terminal points, which was approximately 815 km. (510 miles), the principal difficulty was in the choice of a submarine cable. As gutta-percha cables of the ordinary construction are not suitable for telephone work there were only two constructions, which in principle are totally different from each other, namely, the Pupin and the Krarup systems, that is either a cable with self-induction inserted at certain definite points or distributed uniformly over the whole length. It was finally decided that for the telephone line in question the construction of the cable on the Krarup system would be most suitable.

The cables contain four cores, the construction of each core being as follows: The copper strand consists of a central copper wire surrounded by three flat tapes and has a sectional area of about 5.5 square mm. in all. This copper strand is closely wound with three layers of soft iron wire, .2 mm. in diameter, and is insulated with guttapercha of a special quality to a diameter of 8.4 mm. To minimize the "leakance," a special gutterpercha mixture was chosen which, according to test, was found specially adapted for the purpose. The cores are laid together in pairs and the two pairs are again stranded. The four cores are finally served with brass tape as a protection against the teredo. The main cable is sheathed with twenty-four galvanized iron wires of 5.7 mm. diameter and the shore end with twenty such wires of 7.1 mm. diameter. The laying of these cables was carried out in much the same way as is the laying of telegraph cables. A cargo steamer was equipped with the necessary machinery and the work of laying carried out without difficulty.

After having made the permanent connection between the cable and the aerial line the speaking trials which were made from Zara with the terminal station at Vienna gave excellent results. The tone was loud and the articulation very clear, distinct and well-maintained in spite of the great length of cable. An abnormal leakage from the aerial line is prevalent in this district, caused chiefly by the insulators and iron brackets becoming covered with a thick precipitation of salt which is deposited at times to a depth of ½ inch. For this reason a line loaded with higher self-induction would have been of less advantage.

"Cross talking" such as is sometimes met with in telephone cables was not noticeable with the cable supplied. Further experiments have proved also that both pairs of cores are entirely free from induction.

Further extensions of the line have recently been completed and speaking trials have been carried out between Vienna and Sarajewo, a distance of about 900 miles.

Previous to the laying of the telephone cables described above, speaking trials were made to determine to what extent the volume of sound and the tone of voice would be altered when both pairs of cores were connected in series, thus giving a cable 120 km. in length. Even over this length of cable which was further connected in series with about 500 miles of aerial line the trials are reported to have proven entirely satisfactory.

This cable was manufactured and installed by Messrs. Norddeutsche Seekabelwerke, Aktiengesellschaft, Nordenham, whose agents in Canada are Watson Jack & Company, of Montreal.

Rapid Telephone Growth

At the end of 1911 there were, by official count, 16,160 telephones in use within the city of Vancouver, and that number was increased to 20,752 on December 1, 1912. So rapidly has the Vancouver system developed that it has been necessary to handle city business through four exchanges, and another is soon to be opened in one of the near-by suburbs. A large part of the telephone business of Vancouver is done through the long distance exchanges of the system. Calls to out-of-town points to the number of 38,914 originate in Vancouver every month, and thirty-two employees devote all their time to the operation of long distance exchanges. This service has recently been improved by the installation of a new submarine cable between Vancouver and North Vancouver, on the north shore of Burrard Inlet. The cable is made up of fifty pairs of 87 circuits, paper insulated, lead covered, and steel-wire armoured. It is the second largest telephone cable in use on the continent. In addition to this work a new cable forty miles long is shortly to be laid from Vancouver to Nanaimo on Vancouver Island, and there will be many additions and extensions to switchboards and buildings during the present year.

Fredericton, N.B. Notes

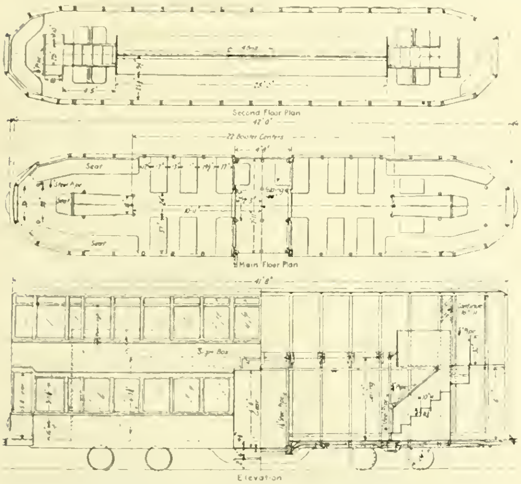
The Public Utilities Commission held a session in St. John on March 25th with reference to rates to be charged by the New Brunswick Telephone Company throughout the province. In towns using 2,000 phones and upwards, the business rate will be $45; residence, $30; two party business, $40; two party residence, $24; four party business, $33; four party residence, $20; eight party residence, $18; rural line business, $24; rural line residence, $18. In towns using 400 phones and upwards, business rate is $30; residence, $25; two party business, $25; residence, $20; four party business, $22; residence, $18; eight party residence, $15; rural line business, $21; residence, $18. 100 phones and upwards, business, $25; residence, $20; four party business, $20; eight party residence, $15; rural line business, $18; residenve, $15. Town systems less than 100 phones, business, $21; residence, $18; two party business, $20; eight party business, $18; residence, $15; rural business, $18; residence, $15. Less than 100 phones in sparsely settled districts, business, $21; residence, $18; two party business, $20; eight party business, $18; residence, $15. The schedule of long distance toll rates is 10c up to 10 miles, 15c up to 15 miles, 20c up to 20 miles, 25c up to 40 miles, 30c up to 50 miles, 35c up to 60 miles, etc.

ELECTRIC RAILWAYS

Double-Deck Car for Washington

A double-deck car, illustrated herewith, and combining several of the features of two designs brought out last summer, is now in course of construction for the Washington Railway & Electric Company, and is described in a current issue of the Electric Railway Journal. The new car embodies several radically new features, most prominent among which is the girder construction of the whole side of the car from side sill to eaves. A center entrance is used and the stairways to the upper deck are at the ends of the car. The height is reduced by the use of 24-inch wheels with small motors to suit.

The car is being built for experimental purposes and it is to be used in different classes of service in the city of Washington to give it a thorough trial. It is being tried with the idea of getting more carrying capacity per unit and per mile of track, as there are some portions of the city where the tracks are very congested during certain hours of the day. The company believes that double-deck cars may



improve the existing conditions, and if its use is found practicable under the local conditions more cars of the type will be purchased.

The design is somewhat along the general lines of the company's center-entrance cars. Two stairways will lead from the center of each end of the car to the second floor. These stairways will be constructed with a platform two steps below the upper floor level and at that point will turn to the right and left for the final rise up to the second-floor level.

The car will seat 100 passengers, fifty seats being provided on each of the two floors. On the first floor the seats will be transverse except for a short distance near the ends alongside of the stairways where longitudinal seats will be installed. The seats on the second floor will be set longitudinally back to back. On each side of the stair walls transverse seats, each seating one person, will be provided, so that all of the available space of the upper deck will be used for seats.

The car will be 42 feet over all and have a width over sills of 8 ft. 6 in. The extreme height will be 15 ft. in. and the first floor will have a clear standing height of 6 ft. 1 in. Access to the car will be effected through a wide center-entrance doorway for which folding doors will be provided. These doors will be operated manually and fold up into two sections at each side of the opening. The floor at the center of the car will be depressed to form a well and this will permit the use of very low steps to the ground level. As shown in the accompanying line cut, space for the motorman will be provided in front of the stairway and no separate cab will be installed for him.

The electric equipment will consist of four G. E. No. 236 motors. These are of a special design and have a capacity of 32 h.p. each. They will be mounted on specially designed trucks of the inside-hung type, all wheels being 24 inches in diameter.

The most radically new feature of the construction is that the sheathing for both the upper and lower decks will be made of steel plate. At the ends of the car, in the position which would ordinarily be taken by the corner posts of a standard car, latticed steel columns will be used rigidly framed into the steel sheathing of both decks and connected also to the plate at the eaves. This construction permits the whole side of the car from side sill to roof to assist, by its action as a girder, in supporting the weight of the car and its load.

Montreal Tramways

In view of the public agitation against the service of the Montreal Tramways Company, the company have drawn up plans which, if agreed to by the Council, will involve the expenditure of between $8,000,000 and $10,000,000. The directors are prepared to enter into a new contract, but they must be granted they say new routes if the congestion is to be remedied. It will be necessary to order 200 cars in addition to those now being built. Mr. Robert, the president, makes eleven suggestions, which include double tracking and the building of subways under the Lachine Canal. He says the company are prepared to discuss the opening up of Vitre street, the extension of the Guy and Beaver Hall line, the straightening out of Guy street, the opening up of Sherbrooke street, the extension of the Beaver Hall line to St. Lawrence Boulevard, the granting of new rules to the northern side of the city, the extension of the Papineau avenue line, the opening up of William street, the construction of subways under the Grand Trunk Railway at various points, and the opening up of Decarie avenue, Notre Dame de Grace, to the back of the mountain.

Mr. Duncan McDonald, former manager of the company, has also, at the instance of a Montreal paper, made an exhaustive report on the situation. He recommends the construction of a subway and the opening of seven new routes. In addition to this, he suggests schemes for the avoidance of congestion, and a long list of improvements to existing lines as well as for minor routes in various parts of the city. In his view most of the new routes suggested to take care of overloading in the northern part of the city and other troubles can be put into operation at very early dates. Mr. McDonald closes his report by expressing the opinion that subway operation is the most practical, effective, and profitable means of handling traffic in large cities, and that in the very near future the traffic of Montreal must be handled by the operation of subway trains.

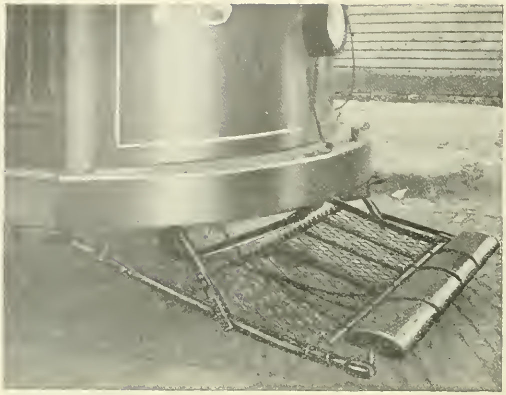


Fig. 1

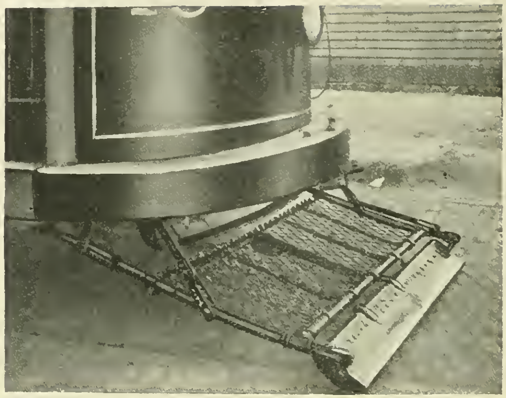


Fig. 2

New Type of Fender

A new type of projecting fender possessing a number of unique features has just been placed on the market by the Fonger Fender Company. The illustrations given herewith show the fender in different positions, viz.: Fig. 1, the normal or projecting position of the fender; fig. 2, the scooping position of the fender; fig. 3, showing swinging position of fender, and fig. 4, showing fender folded in a practically concealed position.

The most unusual feature of this new fender is a tilting shield at the lower end of the baskets which, upon coming in contact with any object on the track, automatically turns forward and serves as a scoop, fig. 2, in picking up the object encountered. In its operating position the fender projects less than 2 feet beyond the bumper and it is so attached to the car by pivoted hanger rods that it may be swung entirely out of the way beneath the care when not required for use.

Another of the advantages claimed for this fender is that it can be released instantly from its operating position and swung back under the platform of the car when a collision with a vehicle or other body is imminent. This is accomplished by the motorman simply putting his foot on a plunger in the floor. The position of the fender is in fact governed by the judgment of the motorman as a foot lever and chain enables him to set the fender in the operating or the carrying position at will.

The position of the scoop however, is governed by the trigger spring which holds it in the normal operating position. After it has been tripped it is necessary to reverse the scoop and set the trigger by hand. The fender is an all steel construction with the exception of the scoop and is claimed to be strong and durable.

Terminal Facilities for M. & S. C.

A deputation from the South Shore of the St. Lawrence have asked a special civic committee to grant the Montreal and Southern Counties Railway appropriate terminal facilities in Montreal, commensurate with the importance of the line; the committee adjourned the matter for further investigation. The present terminus in McGill street is very inconvenient. The route originally proposed by the Company was along Grey Nun street to William street, along the latter, across McGill street, and along the south side of Youville square to St. Peter street. This proposed line was rejected by the committee at a previous meeting, in view of the protests of merchants that the traffic was such that a line of cars was impracticable.

The new electric line running through the Saanich peninsula is nearing completion and it is expected cars will be in operation on or about April 1st, 1913.

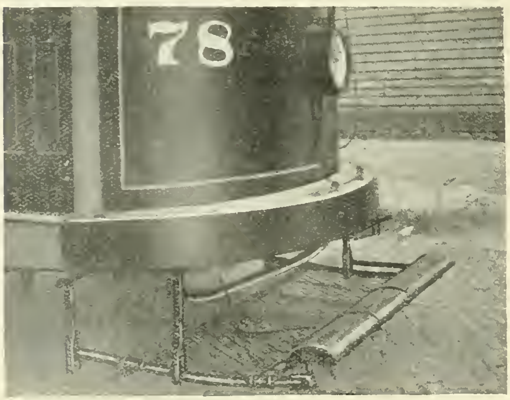


Fig. 3

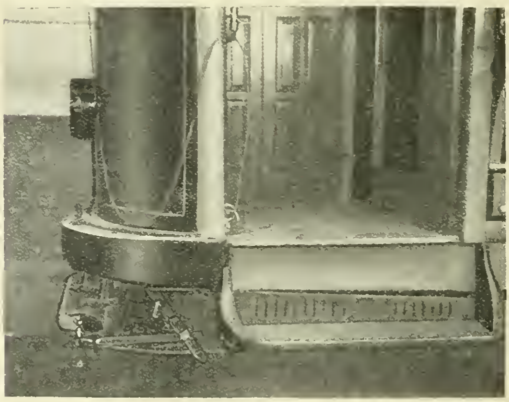


Fig. 4

Illumination

Sign Lighting with Tungsten Lamps

By Mr. O. P. Anderson*

There are to-day approximately 80,000 electric signs in this country. Assuming an average of 100 lamps per sign, this makes a total of approximately 8,000,000 sign lamps in actual service. From these figures the importance of this business in dollars and cents can readily be calculated. Although it may be seen that the revenue from electric signs is already extensive, these figures represent only a small percentage of possible business. In fact, the surface has as yet only been scratched. Before the advent of the drawn wire tungsten sign lamp a number of central stations believed they had reached the "saturation point" with electric signs. The saturation point may have been approached with carbon lamps in a few cases, but this condition has now been changed. The tungsten lamp has opened almost unlimited fields for the use of electric lamps for advertising purposes.

Merchants to-day know the value of electric sign advertising, as is evidenced by the large number of signs which border our principal thoroughfares. Owing to the extreme flexibility of design made possible by the use of incandescent lamps, the sign can be made as plain or fancy as desired. The dealers are satisfied that this is the most efficient method of advertising; that it will attract and compel attention when all other methods fail; that, in fact, it is the most profitable investment they can make. Their only objection has been the cost of operating the old carbon lamps.

Every merchant is in a position to spend a certain percentage of his gross receipts for advertising, including electric signs; but the cost of operating a representative sign with carbon lamps has, in many cases, exceeded that sum, and hence the merchant was compelled to forego the sign. The carbon lamp, however, is now obsolete, it being neither efficient nor attractive. Its place has been taken by the efficient tungsten sign lamp, which removes every objection that any merchant might have had against the old carbon lamp.

The following table gives the total operating cost in dollars per thousand hours with various types of sign lamps, current calculated at 10c per kw. hour.

Table 1

7.5 c.p. 30 watt carbon	$3.10
4.8 c.p. 20 watt carbon	2.10
6.7 c.p. 10 watt mazda	1.20
2 c.p. 10 watt carbon	1.07
3.3 c.p. 5 watt 50-65 v. mazda	.65
3.8 c.p. 5 watt 10-15 v. mazda	.62
1.8 c.p. 2.5 watt, 10-13 v. mazda	.37

In these figures the renewal cost is assumed to be the present standard package price. It will be seen that there is no longer any excuse for the continued use of carbon sign lamps.

Theoretically the operating cost decreases, due to the use of high efficiency tungsten lamps, there is a material increase in the number of consumers. In addition to this the reduction in operating cost makes it possible for existing consumers to burn their signs longer for the same expense, thus getting more advertising, and at the same time greatly improving the load factor of the central station. The gross income to a central station varies with the product of the operating cost per hour, the number of consumers and the number of hours burning. The increase in the number of hours burning and number of consumers will more than offset a decrease in operating cost, the result being a material increase in income to the central station. Therefore, by reducing the operating cost a small amount, it is possible to considerably increase the net profits to the central station, and at the same time give the customer more and better advertising for the same amount of money.

There are a large number of carbon signs throughout the country which are not operated at all, or, at best, only a very short time each night. Clearly this is not profitable business for the central station, nor does it give the merchant results in proportion to his investment. Therefore everything seems to indicate that it is both to the advantage of the central station and merchant that tungsten lamps be used.

Table 2

	10 to 13 v.	50 to 65 v.	100 to 130 v.
Rated and average watts	2.5	5	10
Watts per candle	1.33	1.5	1.5
Lumens per watt	7.46	6.62	6.62
Mean horizontal c.p.	1.8	3.3	6.7
Mean spherical c.p.	1.4	2.6	5.3
Average total life, hours	2000	2000	2000

Table 2 gives the qualifications of tungsten sign lamps in use at the present time. It is now possible to use these lamps on any standard lighting circuit, whether alternating or direct current. The filaments in all tungsten low voltage sign lamps are now made of wire of exactly the same diameter. This means that when these lamps are connected in series and necessarily take the same current they will operate at the same current density and efficiency in watts per candle. This makes it possible to get nearly as good results from series as from multiple operation. Since the diameter of the wire is the same through the entire voltage range, namely, 10 to 13 volts, it is evident that there will be a slight variation in the watts consumed, due to variation in voltage. This is to be desired, however, since the normal amperes are constant. It is therefore possible to operate with entire success a 10 volt lamp in series with 9 and 11 volt lamps. However, this is not recommended as it will be responsible for either an increase or decrease in the efficiency at which all the lamps are operated. In order that there may be no misunderstanding regarding which is, and which is not, the correct way to operate these lamps, each type of lamp will be described separately and recommendations made accordingly.

10 to 13 Volt Lamps

Since these lamps are made for 10 to 13 volts they

* Edison Lamp Works, Harrison, N. J.

necessarily have a comparatively short and thick filament which makes them very rugged and able to withstand severe service.

In cities supplied with alternating current it is always recommended that these lamps be used in connection with a transformer. The expense of the transformer is justified since by its use the best possible performance is secured through multiple operation. It is poor economy, therefore, to wire even small signs in series under these conditions. It is a very simple matter to change over old carbon signs to accommodate these lamps, as it is only necessary to insert a transformer between the service wires and the sign. Care, however, should be taken to see that the size of wire in the sign is heavy enough to carry, without excessive voltage drop, the increased current consumed by the low voltage lamps.

In the past these 10 to 13-volt sign lamps have been a perplexing problem to central stations supplying only direct current. Although many have wired these lamps ten in series with good results, others have had only indifferent success. The difficulty has been largely due to a system of wiring which would permit ten lamps to go out whenever one failed. Since, therefore, the success of series systems of wiring with 10 to 13-volt lamps has been questionable, it is no longer recommended for new sign lamps, especially in view of the fact that the 100 to 130-volt and 50 to 60-volt sign lamps make it possible to employ a better system of wiring. However, should a sign be already wired in series, very good results may be obtained by using carefully selected series sign lamps, the present method of selection allowing every one of the lamps in each series to burn at exactly the same efficiency when consuming the same current. Under no conditions should lamps of different manufacture be operated in the same series.

Although the straight series method of wiring may now be considered obsolete, the multiple series method may still be used with satisfactory results under certain conditions. These conditions are that the sign which is so wired should contain not less than 100 lamps and also that the burnouts be promptly replaced.

50 to 65 Volt Lamps, Two in Series

These lamps will be of great assistance in the sign lighting field, especially for direct current districts. The method of wiring this lamp will be the same on alternating current and direct current circuits. The lamps may be either wired two in series or in multiple-series. In a double face sign it is suggested that each side be wired in multiple, and the two sides placed in series, thus making the condition of operation practically similar to straight multiple. If it is desired to wire two lamps in series it is recommended that the lamps be staggered so that the failure of one lamp will not cause two adjacent lamps to go out. With a double face sign, by wiring one lamp on one side in series with a lamp on the other side, the failure of one lamp will only cause one lamp on each side to go out, and it can readily be seen that with a reasonable amount of care such a sign can always be kept in good condition.

The old signs containing 100 to 130 volt carbon lamps can, in the majority of cases, be re-wired very simply, so as to accommodate these lamps. If it is a double face sign the change can be made by simply connecting one side of the sign in series with the other side at the cutout box. If it is a single face sign, or a double face sign with an equal number of balance circuits, the change can be made by connecting in series two circuits which contain an equal number of lamps. Such changes have been made in a number of cases with satisfaction.

100 to 130 Volt, 10-Watt Lamps

The introduction of these lamps has made possible the simplest and most satisfactory method of operating sign lamps, viz., in straight multiple on standard lighting circuits. Their use means the elimination of a transformer, which will mean a considerable saving in the initial cost. The writer knows of one sign containing about 400 of these lamps which have burned in excess of 2,000 hours, giving an average life of 1,800 hours, with 60 per cent. of the original lamps still in service. The results given in other places, under different conditions, have shown up equally well.

These lamps should prove a blessing to central stations supplying direct current, who have heretofore objected to the series system of wiring. They make it possible to change over all old carbon signs to this lamp without any re-wiring and also to so equip all new signs. In fact there is no logical reason why any new sign should not be supplied with tungsten lamps.

Wiring

The wiring of tungsten sign lamps is very important, especially that of the 10 to 13-volt lamps. It is very essential that the size of the wire be calculated very carefully in order that the Fire Underwriters' rules be not violated, and also in order that the voltage drop be not excessive. According to the Fire Underwriters' rules: "Where wire not inferior in size and insulation to approved No. 14 B. & S. gauge is used, connected direct to standard sockets or receptacles, 1320 watts may be dependent upon final cutout."

Table 3—Capacity in amperes of various sizes of copper wire, and number of 5 and 10-watt lamps that may be operated in multiple thereon.

B. & S. Gauge	Rubber Insulation Amperes	No. 5-Watt 10-13 Volts	No. 5-Watt 50-65 Volts	No. 10-Watt 100-130 Volts
14	12	27	137	137
12	17	38	195	*
10	24	55	275	
8	33	76	*	
6	46	106		
5	54	124		
4	65	149		
3	76	175		
2	90	207		
1	107	246		
0	127	*		

* Exceeds the 1320 watts as allowed by National Board of Fire Underwriters

Table 3 shows the carrying capacity of wires as approved by the National Board of Fire Underwriters, and also the number of tungsten sign lamps, used in multiple, that they may safely carry. It can be seen from this table that the carrying capacity of the wries is the governing feature with low voltage lamps.

With 10 to 13 volt lamps it is very essential that the voltage drop in all cases be less than one-half volt. This is evident, since if a large drop be allowed the percentage drop would be so high that the appearance of the sign would be affected. For instance, a drop of one volt means a drop of 10 per cent., which is entirely too much for satisfactory service.

Table 4 gives the number of lamps that can be operated on each four different sizes of wire with a voltage drop not exceeding one-half volt. Table 5 gives the maximum number of 5 watt, 10 to 13 volt lamps, wired in multiple, that can be supplied from feeders having the size and length in the table, with a drop not exceeding 0.2 volts.

With the 100 to 130 volt 10-watt, and the 50 to 65 volt 5-watt lamps, the ampere rating is very small, and hence the governing feature of the wiring will be the 1320 watts which is imposed by the National Board of Fire Underwriters. With 10 to 13-volt lamps wired in multiple, it is, however, necessary to calculate very carefully the size of wire to be used in each particular sign. Knowing the current to be carried, it is a fairly simple matter to determine

Table 4—Number of 5 watt, 10 to 13-volt lamps that may be operated on each of four sizes of copper wire with a voltage drop not exceeding one-half volt.

Spacing of Lamps in Inches	Size of Wire (B. and S.) 14	12	10	8
3	48*	68*	96*	132*
6	48*	68*	88	112
8	47	60	75	97
10	42	54	68	86
12	38	49	62	79
16	33	42	54	68
20	29	38	48	61

Table 5—Number of 5 watt, 10 to 13-volt lamps wired in multiple that can be supplied from feeders of the various sizes and lengths given, with a drop not exceeding 0.2 v.

Combined Length of Pair of Feeders	Size of Feeder (B. and S.) 10	8	6	4	2
3	64*	92*	130*	184*	262*
4	50	77	125	184*	262*
5	40	62	100	158	254
6	33	53	84	135	210
8	25	40	63	101	160
10	20	31	50	79	127
15	13	21	33	53	85
20	10	15	25	39	63
30	7	10	17	26	42

* These limits cannot be passed without exceeding the safe carrying capacity of the wires.

the size of wire to use by referring to the given wiring tables.

There are several methods of connecting the feeders to the circuits when lamps are wired in multiple that will greatly affect the performance of the lamps. This subject has not been given the attention it deserves, and as a result a number of signs are not operating under the best possible conditions.

Sign lighting is now on a very firm and stable basis. City authorities are very favorably inclined toward it, as it is responsible for lighter and brighter streets, without any additional expense to the tax payers. The merchants are pleased, since they are getting more and better advertising without additional expense. A wonderful advance has been made in the art of manufacturing signs, and as a result sign companies are now erecting better and more artistic signs than ever before. In fact, the present conditions are very favorable for a big increase in the sign lighting industry.

"Good Lighting" Campaign

The Ottawa Electric Company have recently been carrying on a "Good Lighting" campaign which is reported to have met with very satisfactory results from the view point of both consumer and company. The idea originated at a lecture given by Mr. C. A. Howe of the Holophane Company to the merchants of Ottawa some weeks ago. One of the immediate results of this lecture was a number of enquiries received by the company from leading business men regarding the better illumination of their places of business. The outlook being so promising, it was decided to enlist the service of the Holophane Company who, on enquiry, were found to be only too pleased to assist, even going so far as to send their chief engineer Mr. F. F. Groome into the field. Pending Mr. Groome's arrival, however, the company prepared the ground by a little judicious advertising and canvassing. When everything was ready, Mr. Groome arrived upon the scene and got right down to work. A small room in the company's show rooms was fitted up for demonstration purposes and handed over for his exclusive use.

The procedure briefly was as follows: Mr. W. H. McIntyre, superintendent of the New Business Department of the Ottawa Electric Company would take Mr. Groome around and introduce him to the customer. The merchants' wishes being ascertained, measurements, etc., would be taken and recommendations made. This sounds very easy but it is impossible to describe the hours of argument and explanation, the demonstrations and interviews and the time spent in estimatings and figurings of the most exacting nature. That Mr. Groome proved himself equal to the occasion is evidence not only of his expert knowledge and patient good nature but also of the worthy cause in which he was working.

Once the installation was decided upon the work was done as rapidly as possible consistent with efficiency. This part of the campaign was shared with the local electrical contractors, as the Ottawa Electric Company does not keep any regular staff of wiremen.

As illustrating the field covered in the short space of three weeks while this campaign was on, the following are mentioned as a few of the businesses treated with good lighting medicine: wholesale and retail dry goods houses; department stores; tent, awning and lumbermen's supply houses; butcher shops; shoe stores; clothing store (largest in town); the Ottawa public library; the factories of J. W. Woods, Limited; a fine 11-storey new office building and some new business with the Department of Public Works and the new plant of the Beaver Board Company. In addition many enquiries which could not be attended to at the time, were received, but these are being kept ready for a resumption of this campaign at an early date.

It is said that the amount of business taken during this campaign was very considerable. In addition to this there are the two other valuable considerations,—the greater satisfaction among the customers and a distinct advance in the standard of scientific illumination in the city of Ottawa.

Shurlok Prevents Theft

Many buildings suffer by theft of lamps. Strangers strolling through the halls sometimes take the opportunity of removing lamps from the socket, especially since the tungsten type has been in use. To prevent the possibility of removal of lamps, Pass & Seymour have devised their Shurlok type of socket. It is claimed that with this ap-

pliance, illustrated herewith, it is not possible to remove lamps. Aside from the question of theft this appliance will prove valuable in hotels, apartment houses, etc., where it is the custom of the people occupying these rooms to remove the lamp and attach such things as warming pads, curling tongs, flat irons, etc. By the use of such apparatus the electric bills of the owner are enormously and often unnecessarily increased. It is impossible to unlock the Shurlok

with anything but the master key and there are no other keys made like them. This key is not given away but is sold at a regular price, only to responsible persons, a further insurance that the people who would carry off lamps are not likely to have a key.

A Portable Eye-Comfort Lamp

The accompanying illustrations represent a new type of portable lamp just placed on the market by the National X-Ray Reflector Company. This lamp is constructed according to the Eye-Comfort lighting system which has become popular in large public installations but is now applicable in the private home or in any room in the home by use

Fig. 1.

of this portable lamp. The lamp is made in either the floor or table type, the latter being shown in one of the accompanying sketches. The light sources are completely concealed but the arrangement of the lamp is shown in Fig. 2, which explains the mechanism. By pulling the switch E the three lamps marked D on the edge of a disc are lighted. These are not usually larger than 100 watt mazda and serve only to give the shade and the illuminated decorative effect of the usual art lamp to light the space immediately below the lamp. A general illumination of the room is obtained,

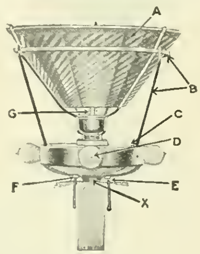


Fig. 2.

however, by pulling switch F, which lights a large mazda lamp G contained within an opaque X-Ray reflector A. This reflector is held in the correct position with relation to the lamp to secure proper illuminating results, by the holder B. The bottom of the X-Ray reflector is open slightly so that a small per cent. of the light from the large lamp strikes the white upper surface of the disc C and is reflected against and illuminates the shade. This makes the use of the small lamps unnecessary when the indirect light is turned on.

Lecture on Illumination

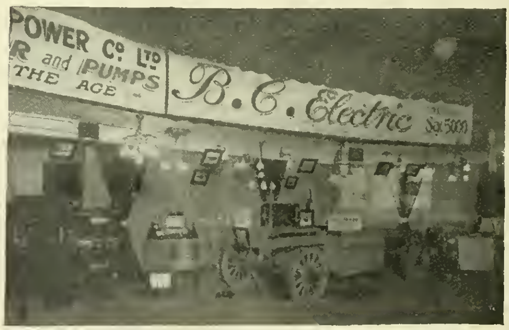
A meeting of the Hamilton Electric Light & Power Company section of the N.E.L.A. was held in the Terminal Building, Hamilton, on Wednesday evening, March 5th, this being the first meeting held since the fine new quarters provided by Manager Coleman for the use of the section have been completed. The room is a good large one on the third floor of the Terminal Building, being 40 ft. x 50 ft., well lighted, heated and ventilated, and artistically decorated. Mr. C. A. Howe, manager of the Holophane Company, Toronto, delivered an address on "Illumination," illustrated by a number of practical demonstrations. There was a large attendance and a great deal of interest was evinced by those present. Addresses were made by Manager Coleman and L. W. Pratt, president of the section. Musical numbers were furnished by Messrs. Kingan, Taylor and Warden.

Truro, N.S. Without Light

Following a series of unfruitful negotiations between the town council and the Chambers Electric Light and Power Company, Limited, on the question of street lighting rates, it is reported power was finally cut off on March 1st, leaving the town in darkness. The rates submitted by the company were as follows: First 100-25 candle power lamps, $22 each per year; second 100-25 candlepower lamps, $18 each per year; third 100 $10; over 300, $5. If 32 candle power lamps were used, an additional charge of $1.50 per lamp was to be paid. If 40 candle power lamps were used, an additional charge of $3 per lamp would be made. Discount 10 per cent. As this rate was not considered satisfactory by the council the company carried out their threat of cutting off supply.

Utilities Exhibit in Vancouver

During February a pure food show was held in Vancouver, B.C., the exhibition being open afternoons and evenings for two weeks. The B. C. Electric Railway Company, Limited, took advantage of the opportunity to exploit its line of electrical appliances, and its booth attracted con-



siderable attention. The exhibits of the company included electric ranges, toasters, percolators and other appliances, all of which were demonstrated by the clerks. On the closing Saturday of the exhibition a popcorn party was held, at which corn was popped on electric grills and distributed to the children in bags which advertised the electrical appliances. The exhibit was considered by the company to have attained good results with reference to the extension of the use of electrical appliances.

The Dealer and Contractor

The Contractor as a Business Man

In the March 15th number of the Electrical News, an interesting article written by a successful contractor on the subject of "The Large Percentage of Failures of Electrical Contractors," has been read with much interest. The weakness of the electrical contractor seems to be, not that he does poor work, but that he takes too little care to see that he makes a reasonable profit. Some of the reasons were outlined in the above mentioned article and one simple remedy at least suggested.

It is perhaps of interest to learn that the electrical contractor in the United States is in much the same position as the Canadian contractor, though this knowledge will probably not carry a great deal of satisfaction. That this is the case, however, is shown by an article recently printed in the National Electrical Contractor, which we reproduce herewith in part, as the conditions there are much the same as in Canada. The article is by Mr. W. S. Hanbridge.

"The average man doing electrical contracting business makes the common mistake of thinking he knows when he really does not know. He starts in with a few thousand dollars, plenty of ambition and a good supply of experience from a mechanical standpoint, but none from the business point. The first mistake he makes is when he falls the victim of the salesmen from the manufacturers and jobbers. Their credit man has told them that the contractor's credit is good for so much. Each salesman does his best, and quite right, to get into the good graces of the contractor and turn as much of his ready cash into stock as possible. This, I believe, is mistake number one. There would be a great deal more sense if the credit man would go to the contractor and explain to him the necessity of keeping his assets in ready cash up to the time he has given the matter careful study and got firmly fixed in his mind that the meaning of the word credit is something that must be handled far more carefully than even one's cash, because a man is not expected to have cash at all times, but if he had been careful with his credit it is just as good as cash.

The second mistake is made when the contractor conservatively estimates a job and then concludes that he must meet some one else's figure in order to establish himself and in a very short time he will get into the way of paying more attention to the figures his competitors put in than to his own, and the result is the jobs do not pan out as well as they should and he is not able to meet his obligations as they become due.

Lack of System

Third, and probably one of the most important, is lack of system. Now when I speak of system I do not mean any expensive top-heavy proposition, but I mean a good simple set of books, properly kept up so that at all times a man knows just exactly where he stands. Opinions vary on how much system is necessary for a business. Personally, I believe that if three-fourths of our cut and dried systems were cut out and a little more good common sense used there would be no need of the average small contractor shying at a bookkeeping system for his business. A good careful girl can be employed for $50 or $60 per month and can keep the books for any firm doing a business under $100,000 a year and it will not take all her time, either.

Great care must be taken in the matter of getting out material, seeing that it is properly charged to the right job and that returns are properly credited. This, of course, must be handled by the store-room end, and if properly kept up and placed in the hands of the bookkeeper it is easy to make a permanent record to the proper jobs. The labor should be carefully charged daily or weekly. This will give the contractor a perfect chart of the condition of his jobs at all times. All incidentals, such as cartage, car fare, etc., that can be charged to jobs should be included.

The next item is to know at all times what your overhead costs you by charging every item, including your own salary, rent, insurance, light, phones, etc. It is a simple matter at the end of the month to add this to your bare cost, thereby showing the entire cost of your job. This, compared with the amount billed, shows monthly whether you have been getting enough money for the business you have done. At the end of the year such things as depreciation, interest, wear and tear, loss of bad accounts, up-keep of guarantee, etc., should be added to your cost so that you will not fool yourself by having any leaks.

Have a Simple System

The above can be elaborated as much as one feels he can afford, but if the average contractor would keep the above simple common sense system, study it, know it and be prepared at all times to present it to any jobber or manufacturer it would be very easy for them to show him what his credit should be. In other words, it is seldom that a credit man is fairly acquainted with a contractor's system until such a time as he is called in to save what he can from the wreck, and I would say to the credit man that you would lose less if you studied and assisted your contractor's system, and I would say to the contractor, make your credit man your Father Confessor; don't be afraid to go to them for advice on any financial transaction, and most important of all, take the advice and use it, for remember, while you have been studying the best way to pull in wires, he has been studying credits.

Fourth. The average contractor is too careless of "Quality and Service." Make these two words your motto, keep them before you at all times. Don't let any small personal gain lead you aside from the path, because the man with "Quality and Service" as his motto, demonstrating same at every opportunity, is building up a bulk-head which will satisfy the most careful credit man.

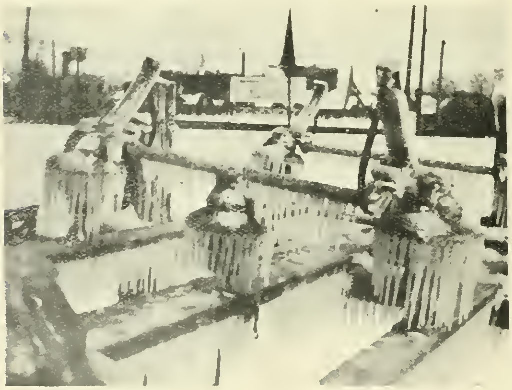
Fifth. Get your bills out as soon as the work is completed, and use the same precaution that your credit man uses with you, get in your money as quickly as possible. Every bill you send out should be carefully followed up and the money obtained. In fact every bill should have a day

of reckoning. If a customer does not pay up on a set day there should be a decided understanding when same should be paid and there should be nothing on your part left undone to further the collection, because outstanding bills never improve. It is your money being backed by your credit and eating up your interest. A prompt collector may sometimes be criticised, but never by the people who are trusting him.

Last and most important of all, meet obligations on the day they are due, and if by accident you are not able, a personal visit to your jobber or manufacturer telling him exactly why you cannot meet it will give him confidence in you. A very common fault with electrical contractors, and probably others, is in reference to this last subject. A contractor does not hesitate to go to a customer seeking a contract. The customer expects the contractor to give him what he is paying for to the letter, therefore, the contractor should not hesitate in having a firm understanding that when his work is done he should get his money, and that said money should be paid at a certain time, and if the customer desires to take a longer time the contractor should impress upon him that it is an accommodation and not part of his regular business. Too many contractors instead of trying to make their customer feel that they are under obligations to the contractor by allowing them time, allow the shoe to be put on the other foot and always feel that they are under obligations to the customer no matter how slow he is."

Operating Air Break High Tension Switches Under Severe Winter Conditions

The rapid development of high tension weatherproof protective and control equipment and the requirements of local conditions have resulted in several distinct types now being tested under actual operating conditions. One of the most difficult tests to secure with high tension air break switches is the effect of sleet or ice. Severe sleet storms are rather infrequent and when they do occur it is often difficult for the switch manufacturer to get on the scene in time to secure essential data. The obvious thing to do, therefore, is to duplicate as nearly as possible the effects of a severe sleet storm as affecting the switch operation,



Voltage tests under operating conditions.

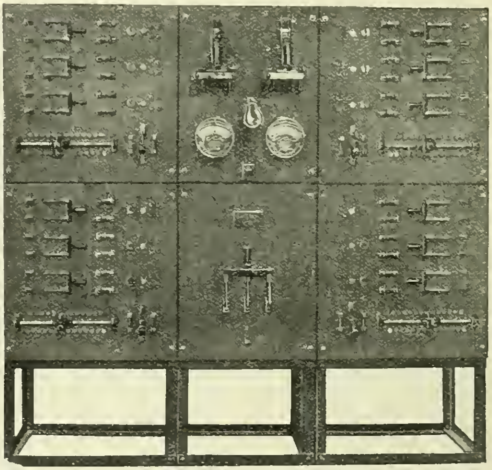
and the accompanying illustration shows a switch used in the test described below.

The switch is of the 3-pole, PM type, manufactured by the Delta-Star Electric Company, Chicago, Ill., and is mounted on a temporary 4-pole structure, although in actual service installations but 2 poles are necessary. With a temperature of 25 degrees F., and wind velocity of 25 miles per hour as recorded by the Weather Bureau, a heavy spray of water was directed on the switch for approximately 2½ hours. The ice deposit secured was very heavy and resulted in many long icicles extending from the insulator petticoats to the channel iron switch mounting. The operating mechanism connecting the three rotating switch arms is located within the central channel iron mounting base and therefore was not affected by the ice formation—only the exposed elements being coated as shown.

Under the conditions illustrated the flash-over occurred at potentials of approximately 51,000 to 57,000 volts. This value was somewhat variable due to the fact that as the voltage was raised and leakage began, the icicles would begin to melt and stream. During the test a spray of water was kept playing on the switch, thus keeping the ice wet. The combination of ice formation, streaming icicles and steady water drizzle was probably equal to the worst winter conditions, and the result secured will form a basis for the company's developments in high tension switches during the coming year. It is said that additional tests on this type of switch will be conducted in the near future and the results obtained and used in further developments now under way.

Baggage Truck Charging Panels

Economy of current consumption is as desirable in the case of charging batteries as in other lines. With this end in view the battery charging equipment illustrated below



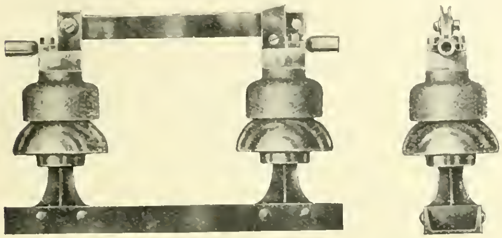
A new battery charging equipment.

and installed in the north station, Boston, of the American Express Company, was designed. This equipment, built by the Cutler-Hammer Manufacturing Company, Wilwaukee, allows for charging 12-cell baggage trucks one at a time, or any number up to 12 trucks at one time. This arrangement, which allows the grouping of trucks on charge, makes unnecessary much wasteful dissipation of current while at the same time keeping the number of separate rheostats to a minimum. There are four charging rheostat panels, two each side of the center panel, and each of these is arranged for charging one truck alone, or two or three in series. The rheostats are of the slider type with resistance grids mounted in frames back of the panels. The double throw switches, above the rheostat contacts, when thrown to the right, connect the batteries of the two or three trucks in series, and when thrown to the left cut into the circuit a fixed block of resistance sufficient to absorb the voltage of the battery at maximum current. The center panel carries single pole cir-

cuit breakers for each of the outside wires of the 3-wire system, on which this equipment is installed, and the meters. In this particular case plug receptacles were placed on the panels with tell-tale lamps opposite each receptacle which indicate when the battery is plugged in.

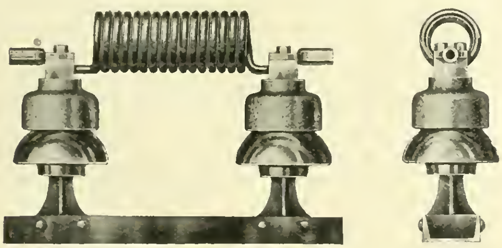
Choke Coils and Disconnecting Switches

The choke coils and disconnecting switches illustrated herewith are typical of a new line of such apparatus recently brought out by the Electric Service Supplies Company. Several unique points in the design of this apparatus may



200 amp. 13,200 v disconnecting switch.

be commented on. The bases of both the choke coils and disconnecting switches are of standard 3 in. channel iron. These bases permit the apparatus to be installed either inside or out, to be attached to switchboards direct, to cross arms, to poles, to pipe or to any other suitable supporting means. Iron pipes are riveted to this channel and insulators, cemented to these pins, support galvanized iron tops, cemented to them, which tops in turn support brass terminal blocks for either the choke coil or the switch mechanism. Choke coils are sweated into these blocks and in every case are provided with separable terminals. The coils are air insulated between turns. This is advantageous, because if arcing should occur between turns, the insulation (air) is



200 amp. 13,200 v. choke coil.

immediately re-established after the passage of the discharge. The manufacturers claim that these choke coils are very rugged in construction, possess great electrical and mechanical strength, and that their design has been worked out so that they afford great protection to electrical apparatus when used in conjunction with their standard types of Garton-Daniels lightning arresters. These choke coils are made for voltage ratings up to 23,000 and for all standard ampere capacities.

In the disconnecting switch, the clips are sweated into the brass terminal blocks, and are made of machine finished, pure, hard-drawn copper. The blades are hung in the clips as shown, and tension screws are provided at each end to secure proper contact. Separable terminals are provided on these switches for all capacities. These disconnecting switches are designed and intended for use not only as lightning arrester disconnecting switches to disconnect arresters from the line for purposes of inspection, repair, etc., but also as switches for disconnecting and controlling high voltage lines, branch feeders, emergency feeders, etc., and for numerous other purposes for which such switches are required. They are made for voltage ratings up to 23,000 and of suitable ampere capacities to meet any operating conditions.

X-Cell with Spring Connections

We illustrate herewith the lastest improvement on X-Cell connections. This well known type of spring connection is soldered to the carbon brass cap of the cell so that loose connections are impossible. By the use of this connection there are no screws to tighten, no plyers are needed, no more sore fingers have to be endured—just press the clip and slip in the wire. This connection has been adopted exclusively by the Bell Telephone Company of Canada, by over 400 other telephone companies and by leading firms in the automobile and general electrical trade. The Canadian patent for this binding post is held by the Canadian Carbon Company, Limited. The advice given by this company is that you install X-Cells with their new spring connectors in your telephone, automobile, engine, motor boat or any where and forget them for "nine lives."

Northern Electric Notes

Great enthusiasm prevailed at the annual hockey games held in the old Victoria Rink to decide who should possess the telephone trophy for the coming year. The Bell Telephone Company's team were the winners last year, but the N. E. boys decided that it should be their turn to bring the cup home. There were two games in the series, the N. E. team winning both; first by a score of three to nothing and the second by a score of three to two. The final game was very close; the Telephone team scored the first two goals in rapid succession, while in the second 20 minutes the N. E. evened matters up. Only one goal was needed in the last half and Hughes was responsible for this.

Messrs. Doherty & Allen are now in the West representing the General Department at the Distributing House Sales Conference, the first of which was held by Montreal during the week of February 7th.

Mr. Ward Still on the Job

In our March 15th number, by a slip of the pen, we were made to say in our personal section that Mr. A. J. Soper had been appointed district sales manager for Ontario for the Northern Electric & Manufacturing Company. This of course, should have been the Imperial Wire & Cable Company as reported in the article under that heading on another page in the same issue. Mr. J. F. Ward is, as everybody knows, in charge of the Toronto office of the Northern Electric & Manufacturing Company.

Change of Address

Macbeth-Evans Glass Company of Pittsburgh, Pa., the makers of the well-known "Alba" glass for high efficiency illumination, owing to increased business and the call for more extensive show-rooms and demonstrating facilities are moving their Toronto sales office and showroom from 70 King street west to 160 Bay street. This change will take place on or about the 1st of April.

Transmission Engineeriug Co.

The Transmission Engineering Company has been organized in Pittsburgh to do special transmission line work. It is affiliated with the Railway & Industrial Engineering Company, manufacturers of the Burke horn-gap apparaturs, and is making a specialty of outdoor steel sub-stations, and special work for terminal towers, station outlets, railroad crossings, and similar requirements. The officers are H. L. Patterson, president; G. N. Lemmon, vice-president and general manager; B. W. Kerr, secretary-treasurer, and A. W. Burke, consulting engineer.

Annual Meeting N. E. L. A.

The 36th annual convention of the National Electric Light Association will be held at the new Medinah Temple, Chicago, June 2, 3, 4, 5 and 6, 1913. The house committee has already sent out a schedule showing the hotels available with the rates charged in each.

The Electrical Repair Company

Announcement is made by the Electrical Repair Company of the opening of new premises at 122 Wellington street west, Toronto, where every facility for the repair of every kind of electrical apparatus is now installed.

Small Refrigerating Machine

The H. W. Johns-Manville Company are distributing a folder describing the Audiffren-Singrun refrigerating machine, for which they are agents. This is a machine operated by a small electric motor of which the power ranges from one-half to four horse power, depending on the cooling effect or ice-making capacity of the machine.

Trade Publications

The Curtis Portable—A bulletin issued by the National X-Ray Reflector Company, descriptive of a portable lamp constructed on the indirect principle.

The Keystone Traveller—March, 1913, issued by the Electric Service Supplies Company, Philadelphia, contains much interesting information regarding this company's products. The publication states the policy of the company regarding the selling of their material and the benefits they have derived by using straightforward methods. A good reproduction of a lightning flash is used to introduce their chapter on Garton Daniels arresters. The booklet also contains other useful and interesting information.

Pneumatic Tools—Catalogue 10 issued by the Pittsburg Pneumatic Company of Canton, Ohio, descriptive of this company's air operated hammers, riveters and other devices. The catalogue is being distributed in Canada by R. E. T. Pringle, Canadian agent.

Electric Grinders—Bulletin No. 23 issued by the Van Dorn & Dutton Company of Cleveland, and distributed by their Canadian agent, R. E. T. Pringle. This bulletin deals with a recently developed line of portable electric grinders in various types.

Shurlok—Bulletin issued by Pass & Seymour, containing facts, entertainingly told, for the man who wishes to protect himself against the loss of lamps.

Catalogue—issued by the F. J. Drake & Company, Chicago, describing their publications, which cover practically every phase of electric, gas, cement, etc., work.

New Books

Electrical Machine Design.—The design and specification of direct and alternating current machinery, by Alexander Gray, Whit. Sch., B.Sc. (Edinburgh and McGill), assistant professor electrical engineering McGill University, Montreal. The McGraw-Hill Book Company, New York, publishers; price $4 net. This book was compiled from a course of lectures on electrical machine design delivered at McGill University. The machines discussed are those which have become more or less standard, namely, direct current generators and motors, alternating current generators, synchronous motors, polyphase induction motors and transformers. The principle followed throughout the work is to build up the design for the given rating by the use of a few fundamental formulae and design constants, the meaning and limits of which are discussed thoroughly and the same procedure has been followed for the several pieces of apparatus. It is pointed out in the preface that the design of electrical machinery is as much an art as a science and that no list of formulae or collection of data is sufficient to enable one to become a successful designer. There is a certain amount of data, however, sifted from the mass of material on the subject which every designer finds convenient to compile for ready reference. This work contains data that the author has found it necessary to tabulate during several years of experience as a designer of electrical apparatus. The book is well printed and illustrated.

Experimental Wireless Stations—By Philip E. Edelman, published by the author at 2432 Lyndale Avenue South, Minneapolis, price $2. This book deals with the theory, design, construction and operation of experimental wireless stations and gives a complete account of sharply tuned modern wireless installations for experimental purposes which comply with the new United States wireless law. The book is intended particularly for experimenters and only matter which directly contributes to the practical presentation of the art has been included. The illustrations, of which there are eighty, consist of simple line drawings to illustrate constructional details, these having been deemed much more useful than half tones, which only show the general appearance of any particular type of instrument.

Alternating Current Machinery.—By Jas. R. Barr, A.M.I.E.E., and R. D. Archibald, B.Sc., A.M.I.E.E., etc.; Whittaker & Company, London and New York, publishers; price 12s. 6d. net. The opening chapter is devoted to a mathematical treatment of complex wave forms; a chapter is devoted to insulation; transformers are treated with regard to their underlying principles, losses and efficiencies, and design; alternators are discussed with reference to their mechanical construction, e.m.f. equations, reaction, regulation, impedance, losses, parallel working and design; three chapters are given to rotary converters under which heading is treated the transforming ratio, armature reaction and windings, voltage regulation, losses, heating, efficiencies, and design. 496 pages, illustrated with 332 photographs and 16 plates.

Baudot Printing Telegraph System—by H. W. Pendry; Whittaker & Company, London and New York, publishers: Price 2s. 6d. net. The adoption and development of the Baudot system by the British Post Office has brought about a demand for information concerning this form of machine telegraphy, which is claimed to be one of the most brilliant achievements of modern invention. This little volume is designed to furnish a treatise which is a comprehensive description of the different features of this system. 144 pages, well illustrated.

The total number of arc lamps in the city of Vancouver at the end of 1912 was 1,669, an addition of 248 lamps during the year. The number of ornamental cluster light standards in use at the end of 1912 was 621, of which number 352 were installed during 1912. Ornamental cluster light standards under construction at the present time are,—Harris street, 76; Hastings street, 44; Granville street, 40; Main street, 59; total 219.

Current News and Notes

Battle Hill, Ont.

Mr. Geo. Cook, Glencoe, is said to contemplate building a dam and installing a power plant.

Brockville, Ont.

The Light & Power Department has instructed Mr. Philip, Superintendent, to get particulars re another pump unit in the pumping station. Manager of Department, Mr. Philip. Engineer, J. H. Bryson.

Representatives of the Morrisburg and Ottawa Electric Railway Company have had an interview with the mayor and council with a view to extending their line to this city, making Brockville a terminal with branch lines through the town.

Bear River, N.S.

The Bear River and Digby Electric Light, Heating and Power Company, Limited, have for sale a 30 kw. C.G.E. alternating current generator, 1,100 volts, 1,500 r.p.m. with switchboard, exciter, etc. Also transformers sufficient for 360-16 candle power lamps at 104 volts.

Brantford, Ont.

It is reported that right-of-way for the Lake Erie and Northern Railway Company has been purchased nearly all the way between Paris and Galt and that work will soon be begun.

The Brantford waterworks system have been quoted a price of $24 per h.p. by the local hydro-electric management. The steam pumps will be kept as auxiliaries or for peak load requirements.

Barrie, Ont.

The profits of the electric light plant for the year ending December 31st, 1912, amounted to $5,000. This corresponds to approximately 20 per cent. of the total receipts. The total liabilities of the corporation in connection with this department are placed at $99,706.

Buckingham, P.Q.

It is reported that work on the new power house being installed at the foot of Dufferin Falls is progressing rapidly and that the plant will be in operation in a couple of months.

Dundas, Ont.

It is reported that Martin H. Hewitt, cement block manufacturer, will require motors for operating new machinery.

Dauphin, Man.

Tenders for electrical machinery were received up to March 19th for the electric light plant of the town of Dauphin, Man. The engine will be a vertical, compound condensing force feed lubrication engine, 360 r.p.m. and a 225 kw. 60-cycle, 2-phase 2,200 volt generator. The requirements also include a switchboard and accessories and a belt driven exciter. Thirty-eight 5-light standards will be installed carrying four 60 watt and one 100 watt tungsten lamps each. Two 10 kw. transformers 2,200/105 volts will also be purchased.

Edmonton, Alta.

Tenders were called up to March 22nd for laying approximately twelve miles of railway track.

Ft. William

The Canadian Car & Foundry Company have recently purchased for their new car shops at Fort William, Ont., a 375 h.p. Robb vertical two-crank ,compound engine for direct connection to a 250 kw. electric generator. This engine, the latest design of Robb vertical compound engines, is to operate at 360 revolutions per minute. It is being built by the International Engineering Works, Limited.

Fredericton, N.B.

A charter has been granted the Suburban Railway Company with powers to build and operate street car lines in the suburbs of the City of St. John.

Fraserville, P.Q.

At the present time the streets are lighted by arc lamps but it is likely the whole system of electric lighting will be renewed within the next year.

Fort Frances, Ont.

A report has been made by the Hydro-electric Power Commission of Ontario on the possibilities of the Sand Island Falls which are said to be capable, under proper storage conditions, of developing 3,000 h.p.

Guelph, Ont.

Application has been made to the Ontario Legislature for authority to pass a by-law to provide for combining the following civic departments, namely: waterworks, gas, electric light, heat, sewage, public works and Guelph Radial Railway under one commission.

Galt, Ont.

This town is now using 1,000 h.p. as compared with 600 h.p. when the system was inaugurated.

The Canada Foundry Company are supplying two centrifugal pumps for the water works department here. These pumps will be driven by one 250 kv.a., 2,200 volt, 3-phase, 25-cycle, 750 r.p.m. Swedish General Electric synchronous motor supplied by Kilmer, Pullen and Burnham. It is expected the installation will be completed about May 1st.

Hamilton, Ont.

An application has been made for an act incorporating the Hamilton Mountain Electric Railway Company.

Harriston, Ont.

After being without street lights for three years current was again turned on March 15th.

Hull, Que.

Extension of railway to Connaught is contemplated. Length—½ mile double track. Weight of rail, 60 lbs.; gauge 4 ft. 8½ in.

Halifax, N.S.

The government has introduced a bill providing for the establishment of a rural telephone system. It is proposed that the government should give a subsidy of $20 per mile, the farmers to furnish and erect the poles, and the government to undertake the stringing of the wires. It is also proposed that the farmers buy their own telephones and pay a small charge for connecting with exchanges in the neighborhood.

A bill has been introduced in the House of Assembly to incorporate the Halifax Tramways and Power Company, Limited. The incorporators are the directors of the Halifax Electric Tramway Company and the objects of the new company are explained to be the development of hydro-electric power and the acquisition of the Halifax Electric Tramway Company. The capital of the new company is placed at $5,000,000. Power would be obtained through the acquisition of the Nova Scotia Power Company which controls the falls on the Gaspereux River.

Kingston, Ont.

The light, heat and power department of the city of Kingston, Ont., are at present installing a 500 kv.a. steam turbo equipment complete with pumps, condensers and new switchboard. This department is also at the present time preparing a report on the local water works condition for which an additional 6,000,000 gallon pump will be required. It has not yet been decided whether steam or electric drive will be installed, but extensions must be made during the present year. Other electrical work in Kingston includes the placing of all wires underground on the main thoroughfare in view of the adoption of permanent pavements. This will also necessitate the installation of new lights for the paved sections. This work is in charge of Mr. C. C. Folger, general manager of the light, heat, power and water departments.

The Board of Trade is again urging the city council to ask the Hydro-electric Power Commission of Ontario to supply them with current from High Falls on the Madawaska River. This matter was considered some time ago, and it was decided that pawer could be produced in Kingston at too low a rate, by steam, to justify the hydro-electric development.

London, Ont.

It has been suggested that in order to relieve the street car congestion from South London a subway be constructed at Ridout street. It is probable however, the improvement would consist of a deep cutting under the Grand Trunk tracks.

The Hydro-electric Power Commission of Ontario who were asked to give a ruling in the dispute between certain members of the council as to the proper cost of street lighting have placed the amount of $29,700 per year. The amount actually charged is $29,000, but it has been maintained by members of the council that this sum was too large by $14,000 or $15,000.

It is said that the London and Lake Erie Transportation Company have made an offer to supply the village with light but the hydro-electric commission does not approve of this plan. It is likely that power will be supplied by the commission.

Lambeth, Ont.

Lambeth Telephone Company, Limited, has been incorporated with a capital of $10,000, to carry on the general business of a telephone company in the Township of Westminster, with head office at Lambeth. The provisional directors are Dr. A. R. Routledge, A. G. Howse, salesman, and Dr. G. A. Routledge, all of Lambeth.

Montreal

At the annual meeting of the Cedars Rapids Manufacturing and Power Company, Montreal, Mr. Howard Murray presiding, the report of the construction work now proceeding was read, it being stated that satisfactory progress is being made. The retiring officers and directors were re-elected.

Shareholders of the Montreal Tramways Company at a special meeting on March 6th authorized the directors to issue $18,000,000 of capital stock in allotments and at prices to be decided on according to the requirements of expanding business and new lines to be constructed. Mr. E. A. Robert, the president, said that no decision had been reached as to when the first issue would be made. He expected that the first issue would be something between three or four million dollars. This would depend on the reports and estimates now being prepared by the engineers and the outcome of any agreement which might be made with the city as to what extensions and improvements should be made. The money would be raised partly by the sale of the unissued common stock and partly by the issue of bonds. The engineers' plans would, it was expected, be ready for consideration at an early meeting of the company.

The Bell Telephone Company propose to lay conduits on about 40 streets in Montreal for the purpose of their own wires, the cost to be borne by the company. The Board of Control of the city have recommended the city to give the necessary authority. The company are to reserve a duct for the police and fire alarm wires, and also to restore all pavements or street surfaces, as well as making a deposit of $12,000 with the city as a guarantee of doing the paving work.

Two of the C. P. R. Telegraph wires between Montreal and Toronto have been equipped with the Morkrum printing telegraph. Each circuit is worked duplex, so that on the two wires two messages can be sent in each direction simultaneously. At the sending end is a keyboard somewhat similar to a typewriter and all that has to be done to transmit a message is for the sending operator to depress the keys in the same manner as though writing a letter or telegram on the typewriter. With the instrument is a recorder which shows exactly what keys have been depressed and whether any mistake has been made. At the receiving end the operator simply feeds in ordinary message blanks as required, and the messages are printed automatically on them. The installation, which was made as an experiment, has turned out satisfactorily.

The Quebec Public Utilities Commission have decided that the Montreal Tramways Company are bound to supply certain information asked for by the Commission. The company denied the authority of the Commission to compel the production of documents relating to the service, condition of roads, etc. Col. Hibbard, the chairman, strongly urged the company and city to get together, so that an adequate service might be provided, and regretted that the Commission had not the jurisdiction to order a remedy, although willing, if required, to act as intermediary. With that hope, the Commission suspended the inquiry into the service of the company.

Mr. Justice Beaudin, Montreal, has given judgment for the defendant in a preliminary stage of the libel action for damages of $650,000 brought by the directors of the Montreal Tramways Company against the "Herald." The latter contended that it was competent to plead that the particular article complained of was to be read in conjunction with other articles on the subject of the tramways management, while the directors held that the defendant would have to stand or fall by the one article. His Lordship dismissed the demurrer, on the ground that it was a case for the judge and jury at the trial to decide.

The March 15th number of the Electrical News was made to say that the Bell Telephone Company would be allowed to erect poles on twenty-three streets in Montreal and that the Montreal Electric Service Commission had submitted plans therewith. We are advised by Prof. Herdt, chairman of this commission that the Electric Service Commission had nothing whatever to do with this matter, did not submit any plans nor make any recommendations regarding service to the telephone customers.

Medicine Hat, Alta.

Complaints are made of the inadequacy of the street lighting in this city, and it is understood that as soon as the street railway question shall have been settled, the lighting system will be fully considered.

Moose Jaw, Sask.

By-laws were recently passed authorizing the expenditure of $75,000 on a fire alarm system and $185,000 for electric light and power extensions.

New Westminster, B.C.

Among the local improvements planned by the B.C.E.R. Company for the year are freight yards capable of accommodating some 500 cars.

The provincial government has decided to light the southern portion of the Fraser Bridge and the approaches thereto. It is said negotiations are proceeding with the Western Canada Power Company for the installation of the lamps and the supply of current.

Ottawa, Ont.

It is said the Ottawa Light, Heat and Power Company contemplate the purchase of electric lighting services and fixtures to cost $250,000.

The Wagner bill introduced recently at Washington and designed to repeal the charter of the Long Sault Development Company passed the senate by a vote of 32-11.

Reported Ottawa Electric Railway will build 1½ miles double track; weight of rail 70 lbs.; gauge 4 ft. 8¾ in.

Orillia, Ont.

It is said that the government's plans with reference to the Trent Valley canal will require the removal of Orillia's present hydro-electric plant to a point some two miles farther down the river.

Port Arthur, Ont.

Tenders received by Commissioner, J. J. Hackney, until March 31st for (a) No. 2/0 round trolley wire, 8 tons; No. 4/0 flexible feeder wire, D.B.W.P., 6¾ tons, (b) rails, spikes, angle bars, bolts, (c) steel intersections, frogs, switches, etc.

Port Moody, B.C.

It is reported plans are now under way for the construction of a tramway line between Port Moody and New Westminster by the B.C.E.R. Company.

Prince Albert, Sask.

It is reported that negotiations have been completed for the purchase of a site for a new telephone exchange. The government will install either the central energy system or an automatic system.

Portage la Prairie

The Bill of the Portage Radial Railway Company passed the Provincial House on February 15th, and is reported to have received such a large measure of financial support as to warrant operations being started immediately. This is an electric road which will operate between Portage la Prairie and Winnipeg, running through St. James, St. Charles and Headingly, and along Pigeon Lake, one of the choicest agricultural districts of the province. To date $25,000 has been subscribed, the amount required by the charter to authorize the company to carry on the business. A large number of subscriptions have been promised from interested farmers along the route and in this way the directors expect that $150,000 will be raised.

Quebec, Que.

Langelier Boulevard will be lighted with new ornamental cluster lights and it is recommended that a number of these lights be placed along the ramparts between the Archbishop's palace and Hamel street and on D'Auteuil street. W. Baillairge is City Engineer.

Rapid City, Man.

The gas electric plant installed by the British Canadian Engineering and Supply Company in this town was placed in operation early in March. The rate to consumers will be 20c per kw. hour with a minimum monthly charge of $1. Mr. T. Towns, formerly of Renfrew, Ont., has been placed in charge of the plant.

Regina, Sask.

Tenders will be received up to April 20th by the city commissioners of Regina, Sask., for one 1,200 kw. synchronous motor generator, or motor converter set, complete with panel for the control of the a.c. motor and generator panel and equalizing pedestal for the control of the d.c. generator.

St. Thomas, Ont.

Plans are to be prepared for putting in crossing with the rail and electric connections complete at William street.

St. John, N.B.

The St. John Railway Company opposed the St. John Suburban Railway Company's bill before the legislature recently on the ground that the former had an exclusive franchise to the streets of St. John city and county and that they were willing to make all necessary extensions.

A recent report made by Mr. J. B. McRae, Ottawa, on the value of the Meductic Falls as a source of hydro-electric power was unfavorable. It is stated that a water project development at this point is not commercially feasible.

St. Stephen, N.B.

Powers of the St. Stephen Electric Railway Company have been extended by the government and they are now able to generate electric power and dispose of it for all commercial purposes.

Swift Current, Sask.

Time is extended to April 14th for receiving tenders for 1-200 kw. and 1-400 kw. a.c. generator direct connected to high speed vertical engines or horizontal turbines.

St. Catharines

The Niagara, St. Catharines & Toronto Railway Company are busy building their extension from St. Catharines to Niagara-on-the-Lake, a distance of twelve miles. Orders have been placed for two 500 kw. C. G. E. rotary converters and transformers for St. Catharines and a 750 kw. Westinghouse rotary and transformers for Niagara-on-the-Lake. The 300 kw. rotary now in the St. Catharines station will be removed to Niagara Falls, Ont., and placed in the sub-station there.

Saskatoon, Sask.

The reports submitted by electrical superintendent Hanson for the month of February show a peak load of 2,420 kilowatts. During the month 581,266 kilowatt hours were generated producing a revenue of $32,011 or 5.5c per kw. hour. This was at a cost of 1,447 tons of coal which works out to 4.5 pounds of coal per kw. hour.

Sunday cars operated for the first time on March 9th and were patronized to the extent of 8,522 passengers, the receipts amounting to $426.10.

Stratford, Ont.

The Stratford Street Railway Company, in making an agreement with the city of Stratford, introduced the condition that they could use power supplied by the Hydro-electric Power Commission or from any other source, as they

found it cheapest. This clause was recently approved by a vote of the citizens of Stratford, but the Ontario government has intervened and the clause is cut out of the bill as not being in accordance with the agreement existing between the city of Stratford and the power commission.

Silverton, B.C.

It is stated that a contract has been closed with the New Denver Electric Light Company to run a power line to Silverton and supply light and power.

Toronto, Ont.

The Ontario Railway Board has approved the plans of the Toronto and Suburban Railway Company to run a line from Toronto through the county of Wellington to the city of Guelph.

All the Canadian Pacific Railway telegraph wires running into the central office are being placed underground from the Board of Trade building at Front and Yonge to the Canadian Pacific Railway building at King and Yonge streets.

The Ontario Railway Board have given orders that the Toronto suburban railway must have in operation the lines on Annette street and Pacific avenue not later than December 1st of this year. The line will be single track.

In the March 15th number of the Electrical News, an article on the subject of ozone purified air, by Mr. S. W. Canniff, was made to say that in the subways of London, Eng., 8,000,000 cubic feet of air are ozonized daily. Mr. Canniff wishes to correct this number, which should have read 80,000,000 cubic feet of air per day.

A suggestion has been made that the local improvement plan should be applied to the extension of civic street car lines in Toronto.

The Forest Hill Electric Railway Company were successful in getting their bill through the railway committee. This will mean the granting of a charter to construct and maintain a railway on Forest Hill Road along Eglington avenue and north on Dufferin and Bathurst streets.

Teeswater, Ont.

It is reported a number of new lights, wiring, etc., will be purchased for extensions to be made to the lighting system.

Vernon, B.C.

Tenders will be received up to April 11th, for the supply and installation of a 500 B. h.p. Diesel engine, a 375 kw. 2,300 volt, 3-phase, 60 cycle generator with direct connected exciter and a 10-ton travelling crane.

On March 10th, the following by-laws were passed: $35,000 for reconstructing the electric lighting system, $50,000 to extend the electric light plant and $15,000 to make extensions to the electric lighting plant and to construct a power house.

Victoria, B.C.

It is said that the p.a.y.e. system will soon be installed on a number of lines of the B.C.E.R. Company's system here.

It is said an attempt is being made to remove all the poles on Government street between Humboldt and Cormorant and to support all wires from the walls of the buildings lining this street.

Vancouver, B.C.

The civic authorities of Vancouver recently met chief engineer Conway of the British Columbia Electric Railway Company and discussed the possibility of the company placing its wires through the centre of the city in underground conduits. It is stated that Mr. Conway promised that within a few weeks he would submit plans showing an extensive system of underground conduit work for the city business district. In carrying out this project the city will have, as far as possible, the conduits laid in the lanes.

Following on the agreement of the Western Canada Power Company to supply 40,000 horse-power to the British Columbia Electric Railway Company, new arrangements for financing the company have been approved. A syndicate of New York bankers have organized the Western Canada Public Utilities Company, Limited, and they have agreed to take over $4,000,000 par value of refunding bonds and $2,000,000 par value of the shares of the treasury stock of the Western Canada Power Company, Limited, at prices equal to 90 per cent. of par for the bonds and 80 per cent. of par for the shares.

City Electrician Fletcher has submitted a comparative statement on the cost of electric lighting in ten of the largest western cities to prove that the electric lighting rates in Vancover are too high.

The Canadian Crocker-Wheeler Company, Limited, St. Catharines, Ont., branch office Vancouver, have just recently delivered to the Britannia Mining and Smelting Company, Britannia Beach, B.C., a 150 kw. direct current generator, direct connected to a Pelton water wheel. This generator will supply extra power to the company's mine electric railway, which has been increased in capacity. The extensive plant of the Britannia Mining and Smelting Company is situated on Howe Sound, about 20 miles northwest of Vancouver.

Windsor, Ont.

Tenders have been called for a 200 h.p. generator and 100 ornamental poles to carry five light clusters. An underground distribution system will supply the lighting current.

Wingham, Ont.

Council contemplates the purchase of a new generator and additional electrical equipment.

Westmount, Que.

Money has been voted for purchase of arc lamps to cost approximately $1,500.

Winnipeg, Man.

Contract has been awarded to The Canadian Westinghouse Company for 9,000 kw. transformer capacity.

Contract has been awarded to the Canadian Crocker Wheeler Company, St. Catharines, Ont., for 1-130 h.p. slipring, constant speed, induction motor, 3-phase, 550 volts, 60-cycle, 720 r.p.m., and 1-40 h.p. squirrel cage, constant speed, induction motor, 550 volts, 3-phase, 60-cycle, 1,200 r.p.m. for city quarry at Stony Mountain.

Tenders are called to May 15 for two 3-phase generators, 3,000 kv.a., 60 cycle, 6600 volt, for power house at Point du Bois.

Welland, Ont.

It is reported that the Welland Electric Company, in competition with which a municipal plant is being installed, are reducing their rates considerably.

Yarmouth, N.S.

The Grand Hotel Company will ask tenders re installing an up-to-date electric passenger elevator in their 4-storey hotel.

New Companies

The Mission Fixture Company has been incorporated with head office at Vancouver.

The British American Manufacturing & Power Company has been incorporated with head office at Vancouver.

Electrical News
Generation, Transmission and Application of Electricity

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Vol. 22 Toronto, April 15, 1913 No. 8

Toronto Hydro issues Good Report

The Toronto Hydro-electric Light & Power Commission have just issued the second annual report of the operations of Toronto's electric distribution system. As expected from the rapid expansion of the system during the last six months a neat surplus is now being shown over all expenditures and the indications are that the year 1913 will show still more satisfactory results. Conservative estimates compiled from present business receipts place the 1913 surplus at well over $100,000.

It will be remembered that the total amount set aside for this system is now $4,500,000. Of this amount $3,734,911 has been expended to date, leaving a balance of $765,089, which, the report states, will be ample to complete the work for which the original sum was voted. The gross income for the year ending December 31st, 1912, is $726,763.55. Of this amount the cost of electric current and the expenses of operation and management, including repairs and maintenance, absorbed $500,564.26; the interest charged against current operations for the year, the sinking fund instalments for the year, and provision for the depreciation reserve fund absorbed $212,643.88. There is therefore left, as net surplus earnings, the sum of $13,555.41.

In the early stages of the history of the Toronto Hydro-electric Commission while the work of construction was under way, the plan was naturally followed of charging the interest on capital account against capital. During the first nine months of 1912, the business had developed to such an extent that the policy was adopted of charging only half this interest to capital account the other half being charged against expense account. During the last three months of the year we understand, however, that all this interest as well as every other legitimate expense was charged against earnings and that during this period the income was more than sufficient to meet the total demands made upon it. We understand further that during the first three months of 1913, the earnings have so far exceeded the requirements of operating expenses, new business getting, depreciation, interest on capital account and sinking fund as to leave a surplus which promises net profits for the present year as mentioned above. The net earnings for the year are being applied towards wiping off sinking fund instalments which have been accumulating for the past year and one half, and which now amount to approximately $51,000. The amount of that obligation now carried forward is $37,430, which will easily be cared for during the present year.

The success of the Toronto Hydro-electric System has evidently been satisfactory beyond the hopes of the commissioners themselves and it goes to show that competition is one of the least evils with which industries have to contend in the development of a new country. Without in any apparent way injuring the private company with which the municipality is in competition, the rates of light and power to the average citizen of Toronto have been so reduced that development along electrical lines has far exceeded anything previously experienced in the history of the city.

It is well worthy of note that the auditors employed by the city of Toronto, Jno. Mackay & Company, have a continental record of wide experience and sound judgment in connection with large financial enterprises. Their statement is that no expenditure has been charged to capital account except such as is properly attributable thereto and that in their opinion the annexed revenue account and balance sheet are properly drawn up to exhibit a true and correct view of the state of the affairs of the enterprise. The report appears in full at another place in this issue.

Electric Heating and Cooking

The British Columbia Electric Railway Company, Victoria, B.C., working in conjunction with the various electrical stores, have devoted considerable energy during the past two years towards popularizing the use of the electric range and the results obtained go to show considerable success. Some 300 installations are now in use including two apartment houses and one electric grill. A rate of 5 cents per kw.h. net is extended to this class of business, which to the ordinary residence with four of a family brings in an average bill of $6.00 per month.

Demonstrations of cookery have been carried out in the early summer months, the equipment being moved around to the prominent corner grocery stores where baking, etc., has been done and refreshments served, and on certain days a full course dinner prepared; these actual tests have gone a long way towards satisfying the housewife of the possibilities of electric cookery. The domestic science rooms of some of the schools have been electrically equipped with ranges, disc stoves, etc., and the younger generation are not slow to realize the advantages offered by a service which now plays such an important factor in many homes.

The heating of offices in Victoria by electricity has also steadily increased. Although the cost is somewhat higher than heating by other means yet the fact of its being clean and hygenic appeals to many, particularly [illegible] er establishments for their offices.

Electric Trucks for Calgary

As indicating the progress of [illegible] the city of Calgary has [illegible] order for [illegible] tric trucks to be used in [illegible] their [illegible] pal operations. The following [illegible] from the report of the

light and power commissioners shows that it was only after the most careful considerations and comparative tests, that electric trucks were chosen as the most suitable for the work to be done. The report is in part as follows:

"In arriving at our decision to recommend the purchase of these trucks, we have received tenders from twenty-six different companies, representing practically all the manufacturers of this class of apparatus, and we have had our engineers carefully tabulate all the tenders, guarantees and the amounts of fixed and operating charges of the various makes of gasoline and electric trucks. After the completion of this work by our own engineers, we consulted with experts and the results of the combined opinion has favored the adoption of motor trucks over our present method of transportation, and has favored the selection of electric trucks.

In our engineer's estimates the operating costs have been based, as you will note, from the tabulation sheet, upon the use of gasoline at thirty-five cents per gallon and electric current at three cents per kw.h. The results based on these figures greatly favor the electric trucks. As a matter of fact however, the current for the charging of the electric batteries will be taken at off peak load hours, when the cost will be nominal, not exceeding one cent per kw.h.

Your Commissioners would therefore recommend first, the adoption of electric trucks for the purpose mentioned, and second, the acceptance of the tender of the General Supplies Limited, as follows.

2-5 ton street sprinklers, each $5,575	$11,150
2-3 ton trucks, each $4,100	8,200
2-1 ton trucks, each $3,050	6,100
1-5 ton tractor truck, $5,050	5,050
Total	$30,500

The tender of the General Supplies was the lowest received for this apparatus. The trucks they have tendered on, are manufactured by the General Motor Company of Detroit, and Pontiac, Mich."

24,000 h. p. at Jordon River

With the recent letting of a contract for a considerable quantity of machinery for the Jordon River power plant, of the Vancouver Island Power Company, a subsidiary concern of the B.C. Electric Railway Company, Vancouver, the additional power which will be generated at the plant will soon be available. The extent of the improvements to the plant may be judged from the fact that, when completed early next Fall, the company will have expended about $650,000 in excess of the amount first appropriated for the construction of the plant which, it was thought, would be ample to meet all requirements of Victoria and district, for several years. But with the increase in the demand for power for lighting and power purposes, together with the growth of the local tramway system, the B.C. Electric Company has been forced to spend an enormous amount in addition to the power output not only at Jordon River, but also by the construction of its Brentwood Bay plant, an addition to its city steam plant on Store street, and the erection of a sub-station for distribution purposes on Richmond road. This last mentioned plant will be commenced during April, and will cost approximately $75,000.

With the Jordon River plant now running to its capacity of 12,000 horse-power, the work of adding to the plant to permit of the installation of another 12,000 horse-power is being rapidly pushed ahead, the scheme of improvements providing for the installation of other units, over and above those which will be immediately installed and the ultimate capacity will be brought up to between 36,000 and 40,000 horse-power. New reservoirs for storage purposes have recently been constructed, new flumes and other similar works have been installed, and the buildings almost doubled in capacity. A contract has been let to the John McDougall Caledonian Iron Works, of Montreal, for a water wheel of 14,000 horse-power, and later, when the full capacity of the plant is required another such wheel will be installed.

Work on the erection of the line by which the B.C. Electric Railway Company will supply residents of a portion of the Saanich Peninsula, Vancouver Island, with light and power, will be completed early in May, and by the end of the month the up-to-date facilities enjoyed by the residents and business men of Victoria will be available to dwellers in the rural districts. The main feed line will follow the route of the company's suburban tramway line and branches will be run to the various points where the demand for lighting or power facilities are sufficient to warrant the construction.

Construction work on the suburban line in the Saanich district is proceeding rapidly, a steam shovel and a large gang of men being engaged. It is expected that early in May the first regular service will be inaugurated from the city as far, at least, as Todd Inlet. The rolling stock for the new line is gradually arriving.

The transmission line running from the Brentwood Bay plant around the south end of Saanich Arm and up the west shore to the new cement plant at Bamberton Bay, has been completed.

Medicine Hat

City Electrician Brazil reports that inside electrical work in this town is greatly rushed and that during the last three months applications for electric connections resemble a boom. The electric plant which was only installed in September, 1911, is already over-loaded. The equipment consists of two Crosley gas engines, vertical type, four cylinder, direct-connected to two Bergmann generators of 175 kv.a. capacity each. The engines are rated at 250 h.p. Originally there was some difficulty in synchronizing these two machines, but this difficulty has been overcome and at present the plant is operating with entire satisfaction under the management of Mr. G. R. Taylor, plant superintendent. Anticipating a greatly increased demand for power in the very near future, the city is installing a new plant of 750 kw. capacity. These are steam turbine plants, gas being used for fuel. It is expected that this unit will be operated about the last of May.

Already about 1100 h.p. in contracts has been signed up with the various industries throughout the city for delivery as soon as the new plant is in operation.

Sussex, N. B.

The town of Sussex, N.B., has just completed the installation of a new street lighting system. The supply of power for Sussex is obtained from the Sussex Manufacturing Company, dealers in lumber, refrigerators, farm machinery, etc., and the installation of the street lighting system was made by Mr. C. T. Nisbet, electrician for the company. Prior to the installation of the new system, the town was lighted with 32 candle power carbon lamps installed on the multiple system. Now, 100-watt series tungsten lamps are in use with the result that Sussex is one of the best lighted towns in the Maritime Provinces. The circuit is controlled by a constant current regulator, Canadian Westinghouse type, and of ample capacity to fill the requirements of the town for years to come. Two generators of 40 and 60 kw. capacity respectively, driven by 75 and 125 h.p. engines, supply the energy. The company have a franchise for commercial lighting in the town of Sussex and report very satisfactory increases in the use of electric current. The general manager of the company is Mr. W. N. Robinson; president, Mr. S. H. White; electrician, Mr. C. T. Nisbet.

Montreal Electrical Society

In the absence of Mr. P. T. Davies, the president, Mr. T. R. Campbell was in the chair at the first annual dinner of the Montreal Electrical Society, held at the Edinburgh Cafe. The attendance was excellent, and the members spent a particularly pleasant evening, brief speeches being alternated with a musical programme. The toast list was short, the first being proposed by Mr. W. B. Johnson to "The Volts," who were the victors in a membership contest. This ended in an addition of 204 members, and, said Mr. Johnson, was an illustration of the value of co-operation. Mr. T. E. Salter replied, and proposed "The Amperes," to which the chairman replied.

The formation of the society was due to the efforts of Messrs. W. H. Tees, the treasurer, and J. C. Bray, the secretary, and the chairman eulogised the work done by these gentlemen, who, replying, spoke of the growth of the Society. Mr. Tees, with whom the idea started, said that the Society had expanded, and now embraced all branches of the electrical industry. The other speakers included Messrs. U. A. Leduc, T. N. White, J. D. Lachapelle, W. H. Winter, and W. H. Turner, the main topic being the value of such an organization, both for technical and social purposes, and the room for further growth.

Pittsburgh Meeting A.I.E.E.

A regular meeting of the American Institute of Electrical Engineers will be held in Pittsburgh, Friday and Saturday, April 18th and 19th, 1913. This meeting will be held under the auspices of the Committee on the Use of Electricity in Mines, of which Mr. Geo. R. Wood, consulting engineer of the Berwind White Coal Mining Company, is chairman. The program includes the following papers: (1) Purchased Power in Coal Mines; (2) Central Station Power for Mines; (3) Safe-guarding the Use of Electricity in Mines; (4) Electricity as Applied to Mining; (5) Central Station Power for Coal Mines; (6) Alternating Current Motors for the Economic Operation of Mine Fans; (7) Characteristics of Substation Loads at the Anthracite Collieries of the Delaware and Lackawanna Railroad Company; (8) Mining Load for Central Stations.

The subject of electricity in mines has assumed such proportions in the last year or so as to justify a special meeting given over to the discussion of its various phases. Not only are mining people themselves interested, but central station operating companies and manufacturers of electrical apparatus for mines as well.

The Canadian Westinghouse Report

The ninth annual report of the Canadian Westinghouse Company, Limited, shows that the net profits for the year ending December 31st, 1912, were $1,050,123. This compares with $1,010,155 for the previous year, so that although the 1911 record was 45 per cent in excess of the previous high point of the company, the 1912 business is still greater. The assets of the company now amount to $7,843,624 accounted for mainly by a capital stock issue of $4,709,112, a profit and loss account of $1,302,599, depreciation account of $500,000, and inventory adjustment and insurance fund accounts of $100,000 each. The directors of the company are George Westinghouse, president; H. H. Westinghouse, vice-president; L. A. Osborne, vice-president; Paul J. Myler, vice-president and treasurer; T. Ahearn, Sir. Jno. Gibson, J. F. Miller, Warren Y. Soper, C. F. Sise, C. A. Terry, G. E. Tripp; F. A. Merrick is general manager; Jno. H. Kerr, secretary, and N. S. Braden, manager of sales.

Growth of the City of Calgary

City Electrician Outlines Past Year's Progress—Much Valuable Information and Cost Data

The growth of the city of Calgary is well exemplified in the report of city electrician R. A. Brown covering the operations in his department for the year 1912. The report is extracted herewith. Particular interest attaches to Mr. Brown's figures of cost on extension work carried out during the year, his remarks with reference to organization, his outline of the distribution system in Calgary and his data for underground work. It would also appear that the city of Calgary is fortunately situated in its relations to the Calgary Power Company which will soon be in a position to deliver well up to 30,000 h.p. This company is just completing a second pole line with which they hope to guarantee continuity of service.

General

The year has been one of steady growth for all branches of the department. The records show that on December 31st, 1912, we were supplying electricity for light and power to 10,220, of which 4,806 were connected during the year 1912. Following is a statement of the receipts, expenditures and surplus of the department for the past six years.

Year		$	Surplus
1906	Revenue	23,166.98	
	Expenditure	16,518.20	$ 6,648.78
1907	Revenue	58,172.67	
	Expenditure	35,878.37	22,294.30
1908	Revenue	85,560.65	
	Expenditure	58,777.70	26,782.95
1909	Revenue	116,668.36	
	Expenditure	111,481.84	5,183.52
1910	Revenue	193,099.82	
	Expenditure	170,692.50	22,407.32
1911	Revenue	206,227.95	
	Expenditure	202,247.48	3,980.47
1912	Revenue	384,173.32	
	Expenditure	366,382.41	17,790.91

Revenue figures are exclusive of revenue from the street railway department, which in 1912 amounted to $105,091.40.

Rates

The city plant began operations in December, 1905, with a lighting rate of 14c per kw. hour and power rate of 10c per kw. hour. By-laws have since been passed reducing rates as follows:—August, 1908, light 12c, power 7c; April, 1909, light 11c, power 6c; May, 1911, light 9c, power 1 to 2c depending on amount consumed; this reduction was made when the department was first supplied with hydro-electric power; August, 1912, light $7\frac{1}{2}$c.

Following is a detailed statement of receipts and expenditures for the past year.

Receipts

Meter light		$237,635.28	
Meter power	$164,781.98		
Less St. Ry. power	105,091.40	59,690.58	
Flat rate light		32,35[illegible].91	
Flat rate power		3,910.50	
Street light		50,45[illegible].80	
Re-connections		127.25	$384,17[illegible]

Expenditures

Overhead lines		
Labour	$ [illegible]01.46	
Material	8,292.83	$ [illegible],894.29
New services		
Labour	4,367.83	
Material	7,139.54	11,507.37

House connections		
Labour	16,029.18	
Material	4,475.31	20,504.49
Power connections		
Labour	3,496.81	
Material	136.75	3,633.56
Meter a.c. power		
Labour	40.73	
Material	749.50	790.23
Meter a.c. lighting		
Labour	736.04	
Material	7,321.51	8,057.55
Repairs to meters		
Labour	1,455.32	
Material	4,857.97	6,313.29
Arc lamps		
Labour	6,973.90	
Material	16,275.53	23,249.43
Tungstens		
Labour	477.95	
Material	2,456.00	2,933.95
Incandescent street lighting		
Material	265.27	265.27
Underground construction		
Labour	33.80	33.80
Underground conductors		
Labour	17.70	17.70
Office expenses		
Labour	13,678.87	
Material	7,054.78	20,733.65
Sub-station equipment		
Labour	77.40	
Material	310.94	388.34
Sub-stations		
Material	67.24	67.24
Engineering and superintendence		
Labour		
Material	3,506.43	3,506.43
General expenses		1,581.00
Purchased power		119,550.96
Contingency		1,049.00
Insurance		164.05
Bank interest		7,410.70
Debenture interest		21,350.73
Sinking fund		8,453.87
Depreciation		18,552.05
Loss on debentures		3,466.76
Debit to power department		67,119.99
Meter fund account	$9,600.00	
Less expended	6,313.29	3,286.71
Purchase of land		3,500.00
Credit balance—1912		17,790.91
		$384,173.32
Expended from depreciation account—1912		$ 50,387.20

Organization

The first work undertaken in 1912, was that of re-organizing. Officers were put in charge of each important branch of the department, who are held entirely responsible for the proper carrying out of all work coming under their jurisdiction. A Clerk of Works was appointed whose duty it is to keep a record of all time and material on each job, and file a copy of the same in the office, where it is always available for reference.

Distribution Record System—Plans were made of the distributing system, showing all primary lines and location of transformers. All transformers in service have been tested. A filing record system has been installed wherein is kept all data concerning the load and general characteristics of each transformer, as also a plan of the secondary circuit to which the transformer is connected.

Meter Filing—A meter filing record card system has also been installed wherein is kept the meter location, a curve showing its accuracy, when last tested also the capacity, reading and date meter was set and first put into service.

Service.—The light and power service throughout the year has by no means been satisfactory, for, while we have been successful in arranging the lines and equipment of our distribution system, so as to give uniform voltage to practically all customers to within the allowed limits of 3½ to 4 per cent., still, the numerous interruptions and unstable voltage of the service has been the cause of great inconveniences to our customers. Everything possible is being done to correct both of these conditions. In fact the latter condition has already been remedied on the greater part of the system, by the improved voltage regulations of the Calgary Power Company supply, and the installing of automatic feeder regulators on all important lighting circuits; these regulators are set to give the desired voltage at the center of distribution and are checked by recording meters at regular intervals, when any variations from normal are noted and corrected. Every precaution is now being taken both by the Calgary Power Company and ourselves to safeguard and better the service. To this end our auxiliary plant is kept under steam at all times, ready to take up at a moment's notice the most important part of our lighting and power load.

12,000 Volt System

This consists of 8¼ miles of overhead 3-phase, No. 00 bare copper wire; 23,635 ft. of No. 00 12,000 volt, three-phase, paper insulated, lead covered underground cable; 338 forty-five foot poles, and the necessary cross-arms, insulators, etc. The overhead lines inter-connect the Calgary Power Company's sub-station in East Calgary with the city sub-station at Ogden, through a one-circuit line, and also connect the Power Company's sub-station with the city's generating station in Victoria Park, through two separate three-phase lines. The underground cable of this system inter-connects the generating station and the new sub-station on Ninth ave. and Seventh street west, through two separate three-phase cables; each cable being of sufficient capacity to supply the maximum power required for the station, so that in case of trouble on either cable, the other is capable of carrying the load while repairs are being carried out.

2300 Volt Distribution

The current is distributed throughout the city, over twelve 2,300 volt, three-phase circuits ranging in size from No. 0 to 300,000 circular mils. Underground feeder cables are used to supply the current to the centre of distribution of the most important lighting circuits, with the object of making the source of supply as reliable as possible. The 2300 volt system consists of 198.93 miles of pole line, containing 10,348 poles, 294,671½ pounds of copper wire, 16,348 ft. of 2300 volt, three-conductor, lead-covered cable, and 1036 service transformers, ranging in capacity from .6 of a kw. to 100 kw. and having an aggregate capacity of 8,865.6 kv.a. There are 696 transformers with an aggregate capacity of 4,181.6 kv. used for lighting and small motor service, and 340 transformers with a normal rating of 4,684 kv.a. in use for power purposes only.

The approximate yearly core and copper losses of the service transformers is 1,260,000 kw.h. Taking current at 1½c per kw.h. this is equivalent to $18,900 per year.

Secondary Distribution

From the transformers the current is distributed to the customers over secondary feeders, which are mostly single phase, three-wire, 110 and 220 volts for lighting, and three-phase, 220 volts for power. There are 273,437½ pounds of

copper wire in service for secondary distribution, and 90,-343½ pounds for service leads.

The department has in service 10,106 meters, ranging in capacity from 5 to 200 amperes. The combined shunt losses of all meters equals 205,000 kw.h. With current at 1½ cents per kw.h. this is equivalent to $3,075 per year.

Street Lighting

The street lighting consists of 1,100 lights, of which 600 are magnetite arcs, 260 enclosed arcs, and 240 250-watt, 6.6 amp. tungstens. The lights are placed approximately 566 feet apart on avenues, and 346 ft. on streets. They are fed and controlled by nineteen separate circuits, and light 201 miles of the city's streets and avenues.

The ornamental or intensive street lighting which is to be installed in certain sections of our most important business streets is a matter which is now in line for very careful consideration. In the first place, a by-law was passed providing for the installing of five-light ornamental standards, equipped with five 100-watt tungsten lamps on all streets covered by the by-law except Eighth ave., where it was provided to use inverted magnetite arcs, with opal globes on ornamental brackets attached to the iron trolley poles. Since the passing of the by-law a large number of magnetite arcs for Eighth avenue have been put into service, and, three blocks of the ornamental standard lighting for Ninth Avenue have been completed. The placing of these lights in service has given an opportunity for all citizens interested to judge as to the merits of the two systems of lighting; it seems to be the concensus of opinion that the Eighth avenue lighting is superior in every respect to that of Ninth avenue. In view of this and the expressed opinion of Commissioner Graves from his personal observation and comparison of the two lighting systems in vogue in the Old Country, and all the principal cities of the East, it is the firm conviction of this department that if it is legally possible, the by-law covering the intensive lighting system should be amended and provision made for the installation of the Magnetite arc system on all the streets and avenues (with the exception of Ninth avenue) enumerated in the by-law.

Sub-Stations

Two sub-stations were constructed and equipped in 1912 one located at Ogden near the entrance of the C. P. R. shops and the other at Seventh street west and Ninth avenue. The Ogden sub-station has a transformer capacity of 3,000 kw. The equipment when installed complete will consist of six 500 kw., 12,000 volt, single phase, step-down transformers; one 500 and one 300 kw. motor-generator set and one arc light regulator, together with necessary switching equipment and control apparatus.

The Ninth avenue and Seventh street west sub-stations have a transforming capacity of 6,000 kv.a. and d.c. generating capacity of 2,000 kw. The equipment when completed will consist of two 3,000 kv.a., three-phase, 12,000 volt transformers, two 1,000 kw. motor-generator sets, six arc light regulators and the necessary automatic voltage regulators, switching equipment, etc.

Underground Conduit System

The underground conduit system consists of 14.94 trench miles of underground conduit, and 94.59 duct miles. Duct ways vary from 1 way to 24 ways.

The number and type of manholes are as follows:—oblong manholes, 80; octagonal, 227; handholes, 2; total manholes, 308; street railway outlets, 10.

Cost and Data of Conduit Construction During 1912

18-way duct.—trench feet, 2,063; duct feet, 37,134. Cost per trench ft., for labor, $.835; material, $2.383; total, $3.218. Cost per duct foot, for labor, $.054; material, $.129; total, $.183.

15-way duct.—trench feet, 483; duct feet, 7,245. Cost per trench foot, for labor, $1.007; material, $2.345; total, $3.352. Cost per duct foot, for labor, $0.065; material, $0.142; total, $0.207.

12-way duct:—trench feet, 1,857; duct feet, 22,284. Cost per trench foot for labor, $0.802; for material, $1.666; total, $2.468. Cost per duct foot for labor, $0.668; for material, $0.138; total, $0.806.

9-way duct:—trench feet, 2,454; duct feet, 22,086. Cost per trench foot for labor, $0.754; for material, $1.328; total, $2.082. Cost per duct foot for labor, $0.837; for material, $0.138; total, $0.975.

8-way duct:—trench feet, 1,624; duct feet, 12,992. Cost per trench foot for labor, $0.625; for material, $1.025; total, $1.650. Cost per duct foot for labor, $0.078; for material, $0.128; total, $0.206.

3-way duct:—trench feet, 4,095; duct feet, 12,285. Cost per trench foot for labor, $0.822; for material, $0.696; total, $1.522. Cost per duct foot for labor, $0.246; for material, $0.232; total, $0.478.

Additional Work to Previous Construction in Same Trench

6-way duct:—trench feet, 12,852; duct feet, 77,112. Cost per trench foot for labor, $0.717; for material, $1.092; total, $1.709. Cost per duct foot for labor, $0.119; for material, $0.284; total, $0.402.

Lane work only:—trench feet, 4,183; duct feet, 25,098. Cost per trench foot for labor, $0.711; for material, $1.220. Cost per duct foot for labor, $0.119; for material, $0.203; total, $0.322.

Paved lane work, complete distribution:—trench feet, 932; duct feet, 3,432. Cost per trench foot for labor, $0.496; for material, $0.883; total, $1.379. Cost per duct foot for labor, $0.134; for material, $0.241; total, $0.375.

6-way duct:—conduit and pipe total equals trench feet (unpaved work—lanes—complete distribution):—trench feet, 2,122; duct feet, 8,592. Cost per trench ft. for labor, $0.435; for material, $0.785; total, $1.220. Cost per duct ft. for labor, $0.137; for material, $0.203; total, $0.340.

Approximate amount of gravel used on the above work was 2,934 cu. yd., varying in price from $0.85 to $1.61 per yd. f.o.b. at points required.

Cost of Manhole

The approximate cost of a 6 x 7 ft. manhole figures out as follows:—

Foreman, 5 hours	$ 2.00
Carpenter, erecting and removing forms	3.60
Labor, excavating	10.80
Mixing and placing concrete	9.00
Team moving dirt and hauling gravel	6.00
Cement, 30 bags, 80c.	24.00
Gravel, 7 cu. yds., $1.25	8.75
Manhole casting	56.70
Steel rails and reinforcement for same	9.15
Total	$130.00

Power

Calgary for the past eighteen months has been receiving the bulk of its electrical energy for light and power purposes from the Calgary Power Company's hydro-electric generating plant located at Horseshoe Falls a distance of approximately fifty-eight miles from the city. The power supplied by the company until just recently was delivered over a one-circuit transmission line, which was the cause of the majority of the numerous interruptions in the service, during the past year. The company now has its second line in operation and we feel that it will greatly improve conditions as regards continuity of service. I understand as a further precaution the company intend increasing the number of poles on that portion of their transmission line subject to

very severe winds, with the hope of practically eliminating transmission line troubles; it is also the intention of the company to extend their Horseshoe Falls plant by adding to its present equipment one 6,000 h.p. hydro-electric unit and two 3,000 kw. transformers, together with the necessary switching and control apparatus. With these additions, this plant will be capable of developing approximately 18,000 horse power during the seasons of the year when water conditions will permit. It is also understood the company will immediately start work on the construction of a new generating station at Kananaskis Falls, which is to have a capacity of 10,000 horse power. It looks as though Calgary in the very near future will be receiving from the power company a thoroughly reliable power service for the twelve months of the year and to the extent of at least the minimum to be contracted for, i.e., 5,000 horse power.

It is unfortunate that the natural characteristics of the country are not favorable to the generating of electric power by means of hydro-electric development, which is due to the very low water conditions of the rivers during the winter months, when the demand for power is the greatest. However, Calgary is in a much better position to deal with its power situation than most cities of Western Canada, for it has numerous possibilities of coping with the future needs of the city for the large amount of power that will be required for domestic and street lighting, and for operating the machinery of the numerous industries which our fast growing and prosperous city will naturally attract. We are fortunate in that in our new agreement with the Calgary Power Company we will have the first call on the company's two plants up to whatever minimum the council see fit to contract for, and the company are capable of continuously delivering.

For the additional power which we shall need over and above that which the Calgary Power Company can be relied on to continuously supply, we have the following means from which it can be generated, i.e., coal or gas fired boilers, with steam turbines, or both; coal with gas producers and gas engines, and natural gas with gas engines. The coal propositions require to be considered from two points of view, namely,—the location of the plant at or near a coal mine and transmit the power electrically to the city, or the location of the power plant in the city and the using of rail delivered coal. The generating of power from natural gas must also be considered practically from the same points of view, that is, the installing of the power plant at gas wells and transmitting the power electrically or the using of piped gas to a plant located in the city.

It is evident that the task of choosing the best of the above methods of power generation for Calgary to adopt is a very complex one, and the Commissioners are to be commended on using good business judgment when they decided to secure the services of an eminent electrical expert to deal with this question; also to advise us as to the best and most economical layout for our underground system, and proper locations and layout for our sub-stations, also to advise concerning the best operating system, etc., for the department to adopt.

The laying out of a programme such as just mentioned, will put the city in the position that all moneys appropriated for electric light and power purposes will be expended on nothing but what will work into and form part of the ultimate plant to which the city of Calgary will look to for its future supply of electrical energy.

Summary of Work Carried Out By the Department During The Year 1912

82.7 miles of new line constructed.

18.2 miles of line re-constructed.

21 miles of line overhauled.

521 new transformers put into service.

198 transformers changed on account of being over or under loaded.

812 street lights installed and put into service.

3,000 kw. sub-station at Ogden constructed and equipped.

6,000 kw. sub-station at Seventh street west and Ninth avenue constructed and equipped.

6.36 miles of underground conduit installed.

4,806 new customers were connected to our lines.

4,980 h.p. in motors was added to power load.

Another Trent Plant Operating

At Dam No. 5—General Design Identical with Plant at Dam No. 2—Slightly Less Capacity

Early in the present year the second hydro-electric generating plant in the neighborhood of Trenton was placed in commission by the Sidney Electric Power Company, a subsidiary of the Electric Power Company, which operates a comprehensive system in Central Ontario. This last plant to be placed in operation is situated at what is known as Dam No. 5, at Frankford, some 5 miles north of Dam No. 2 which is close to Trenton.

A very complete description of the No. 2 equipment was published in the June, 1912, issue of the Electrical News. In as much as these two plants, at dam No. 2 and dam No. 5, are practically duplicates of one another, this article will deal only with innovations in the number 5 plant which it was found necessary to introduce on account of local conditions.

It will be recalled that at No. 2 there were installed four electrical units of 750 kw. capacity. These operate under a

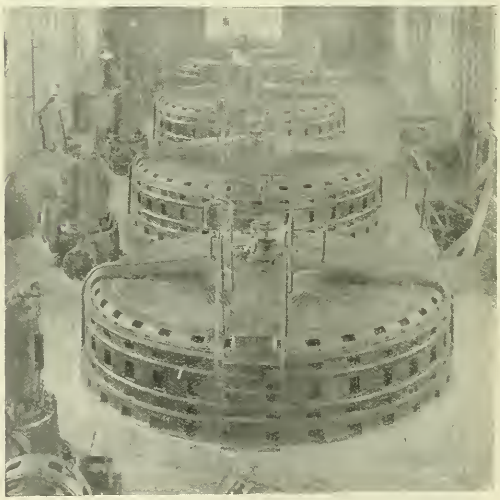


Fig. 1—Four 650 kw. units, dam No. 5, Trent Valley

20 ft. head, the speed being 120 r.p.m. On account of the distance between the two plants being only 5 miles, the variation in the flow of water is very small. The head at No. 5 however, is only 18 ft., 2 ft. less than at No. 2 and on this account it was not possible to operate generators of the same capacity. The main difference in the installed equipment however, is in the speed, which at the upper dam is 112½ revolutions (instead of 120) per minute, along with, of course, the necessary change in the number of poles of the generator. The turbines, therefore, on account of the lower head have a capacity of 1200 h.p. instead of 1400 h.p. at full load and the generators are rated at 650 kw. instead of 750

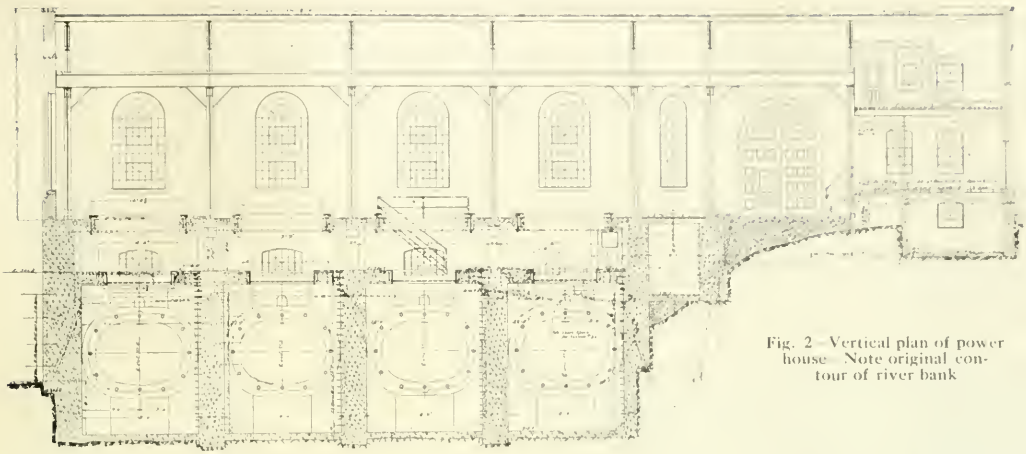


Fig. 2—Vertical plan of power house. Note original contour of river bank

kw. The turbines were again supplied by the Canadian Boving Company, and are of the double runner, vertical type. The oil pressure governors are also Boving type. The generators were, as before, supplied by the Swedish General Electric Company. They are 60-cycle, 3-phase, 7,000 volt, vertical type. There are two exciters, one turbine driven vertical type of 75 kw., 125 volt capacity and one motor generator 75 kw., 125 volt, the motor operating on 2,400 volt, 3-phase, 60-cycle current.

The main difference in the design of the power house is shown in the line sketch in Fig. 2 herewith. It will be seen that an erecting space has been left at the shore end of the power house between the switchboard platform and the exciters, into which space a railway siding runs. The switchboard is situated on a platform at the shore end of the power house 4 ft. above the main floor, thus allowing the switchboard operator a good view of the power house. The switchboard consists of black slate panels, on the back and front of which no voltage higher than 125 is exposed. The 7,000 volt oil switches are situated on frame work far enough back of the board to allow of passage between the operating board and the oil switches. The frame work supporting the latter also carries current and potential transformers, bus-bars, disconnecting switches, etc. The switchboard was furnished by the Monarch Electric Company of Montreal.

A gallery over the switchboard platform contains generator field rheostats, electrolytic lightning arresters, choke coils, line outlets, and a chief operator's office.

The basement under the switchboard platform contains motor driven air compressor and air receiver for cleansing purposes; also oil tank, pump and piping for a lubricating system for the generating bearings.

It will be noticed by reference to the lay-out of Fig. 2, which also shows the original contour of the river bank,

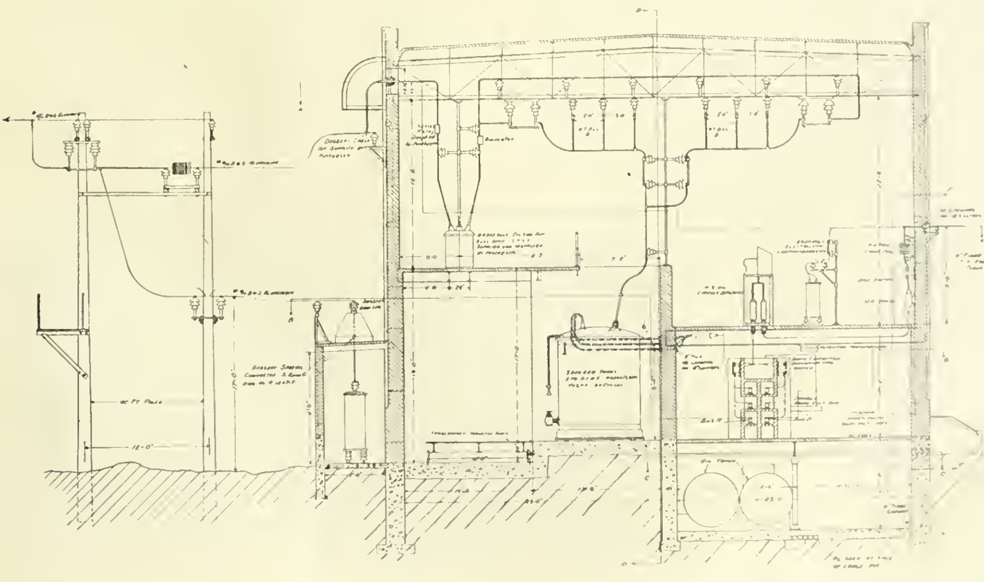


Fig 3—Cross section of transformer station which steps-up current from plants at both dam No. 2 and dam No. 5

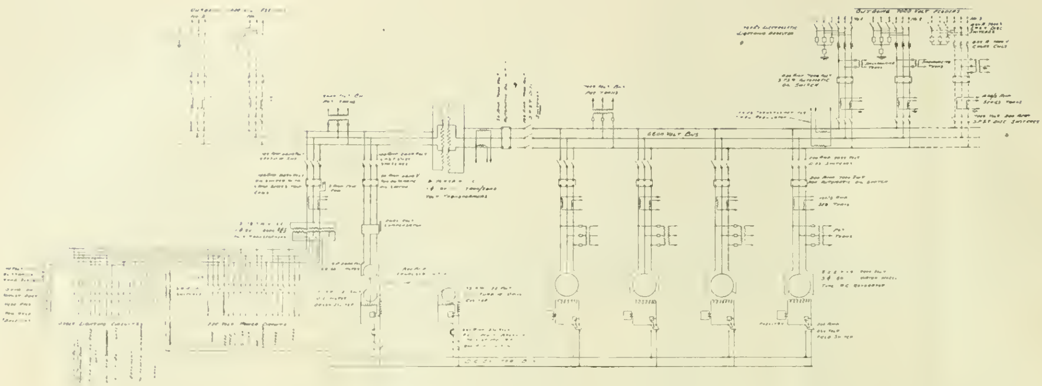


Fig. 4—Wiring diagram, dam No. 5 power house, Trent Valley Canal

how judiciously the power house was designed to avoid unnecessary excavation or filling.

Four 7,000 volt out-going circuits carry the current a distance of 4 miles to dam No. 2 transforming station where it is stepped up to 44,000 volts for transmission over the system of the Electric Power Company. Our article already referred to in the June number of the Electrical News contained a minute description of this transforming station which is designed to take care of the generating capacity at both dam No. 2 and dam No. 5.

The transforming capacity in this station, a plan of which is shown herewith consists of three 3,000 kv.a., 3-phase units which step up from 7,000 to 44,000 volts. The building is 61 ft. 3 in. x 56 ft. 6 in. x 45 ft. high. The transformers have wheels provided in the base and are set on rails laid in the floor so that any unit may be easily shifted. The transformers are of Canadian Westinghouse manufacture as are also the 44,000 circuit breakers. A photograph of the interior of No. 5 generating power house is shown in Fig. 1.

Another Pioneer Gone

Mr. George P. Brophy one of the founders of the Ottawa Electric Railway and the Ottawa Electric Company, superinintendent engineer of the Ottawa river works and one of the most prominent figures in the capital died at his late residence 320 Chapel street, on Friday, April 4th,, of heart trouble, in his 65th year. With the pasing of Mr. Brophy only two of what was known in Ottawa as the "famous five" are left, namely, Thomas Ahearn and Warren Y. Soper. The other two of the quintette were the late Peter Whelen and the late J. W. McRae. None of the five however, had more to do with the once vital question of whether it was possible to run a street railway under Canadian winter conditions than Mr. Brophy. It was owing to his aggressiveness and foresight that what some engineers declared was impossible was successfully overcome.

The late Mr. Brophy was born in Carrillon, Que., in 1848, and was the second son of John B. Brophy and Jane Byrne. His education was obtained in the Ottawa schools. When a young man he accepted a position with the Department of Public Works as a draughtsman and assistant engineer in New Brunswick. After a year in that position he was appointed by the late Hon. Alexander MacKenzie, superintendent engineer of the Ottawa River Works, an office he held up to the time of his death. Besides being one of the founders and a director of the Ottawa Electric Railway Company and the Ottawa Electric Company, he was also a director of the Ottawa Gas Company, and vice-president of the Ottawa Trust and Deposit Company. He also assisted in forming the Ontario Graphite Company, the Ahearn Electric Heating and Manufacturing Company, the Locomotive and Machine Company of Montreal, the Thousand Islands Land Company, the Ontario Smelting, Milling and Refining Company and other smaller concerns. The late Mr. Brophy leaves a widow, one son and four daughters.

Saskatoon, Sask.

As indicating the amount of patronage that may be expected in a city of approximately 25,000 inhabitants, the following figures of the amount of business done every week since the railway was inaugurated on January 1st of this year are valuable. It will be noticed that in less than three months the daily average receipts have almost doubled.

Week ending	Total passengers	Daily av. cash.	Daily aver. no. of passengers
January 4	21,630	$270.35	5,407
January 11	35,626	296.90	5,938
January 18	41,476	345.65	6,913
January 25	40,776	339.80	6,796
February 1	45,320	377.60	7,552
February 8	52,304	435.85	8,717
February 15	51,179	426.50	8,530
February 22	53,015	441.25	8,835
March 1	55,042	458.70	9,174
March 8	65,490	467.80	9,356
March 15	67,428	481.60	9,632
March 22	70,083	500.60	10,112

Long distance telephone charges between England and France are being modified. The price of conservation between Paris and London will be reduced from 8s. to 4s.; between Lyons and London from 10s. to 6s. 2d.; and between Bordeaux and London from 10s. to 8s. The rate for telephoning between Marseilles and Edinburgh will remain at 12s. 6d.

The Newfoundland Government propose to extend the telegraph system around the seaboard of the island, 500 miles having been built in the past four years, with a prospect of 250 more being constructed during the present season; also to build three more wireless stations on Labrador and to establish a telephone system for St. Johns and a number of the outlying places.

Electrical Equipment in the Modern Bank

The new head office of the Bank of Toronto splendidly equipped with generating plant and all auxiliary equipment

Fig. 1

The new head office building of the Bank of Toronto, corner King and Bay streets Toronto, is just nearing completion and, while an example of architectural beauty of the best classic type, it is at the same time one of the most modern and interesting public buildings in Canada from the point of view of its electrical equipment.

The building consists of six storeys, being four above ground with a basement and sub-basement. The sub-basement is occupied principally by the power house, switchboard and auxiliary equipments, boiler room, engines, air cooling and purifying equipment, etc. To guard against any possible contingency due to failure of power supply on the part of the local distributing company, a steam engine driven, direct current generator plant has been installed in the sub-basement to a capacity of 200 kilowatts. There are four generators in the equipment made up of two 75 units and two 25 units, each connected to its own engine; the generators were supplied by the Canadian General Electric Company; the engines are Robb manufacture.

This small isolated generating plant is one of the handsomest to be seen anywhere. The walls and floor are white enamel brick, with floor space of 1800 sq. fet. The main switchboard, some 15 ft. in length, is of 1½ in. grey Tennessee marble specially chosen for this plant. The sides and top of the switchboard are also enclosed with slabs of the same material, adding not only to the appearance of the board but greatly also to the possibilities of keeping the rear of the switchboard clean. Reproductions both of the front and rear of the switchboard are shown herewith. The switchboard which was supplied by the Northern Electric & Manufacturing Company is equipped with all the necessary instruments. To the left are two Weston volt meters. The eight ammeters shown on the main part of the board are also Weston type. At each end to the right and left of the ammeters is a Duncan recording wattmeter. At the centre of the board an Esterline recording volt meter has been installed. The circuit breakers are I T E type.

All generator cables come up through the concrete floor in bushed sleeves which enables all feeders to be carried plumb in the heels of switches and circuit breakers. All feeders throughout the building enter a 15 ft. x 3 ft. x 4 ft. steel junction box where all cables are brought through

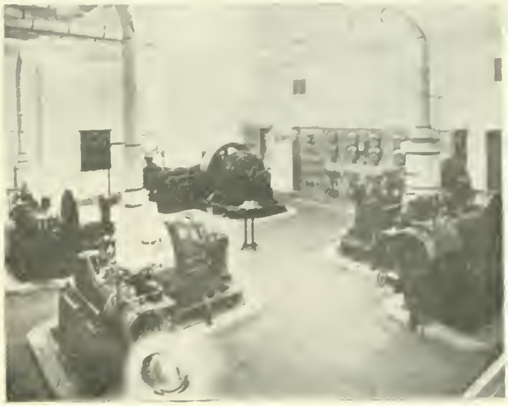


Fig. 3—Steam-electric plant

bushed holes to their respective switches. This does away with all the loose cable work so generally seen under similar circumstances.

The generator room also contains a small motor generator set, 50 amp. 20 volts, chiefly for storage battery work. This is controlled by a battery board which works in conjunction with the motor generator and the batteries through eight branch switches, one motor switch, one generator switch, and two charge and discharge switches. The board carries three ammeters and one volt meter, pilot lights, etc.

The battery consists of [illegible] cells. These are used chiefly for the telephones, call bells, and [illegible] [illegible]

[illegible]

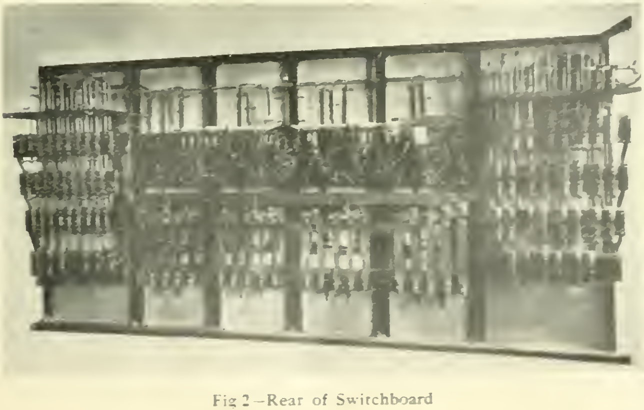


Fig 2—Rear of Switchboard

second floor. Two of these clocks will present a particularly handsome appearance. These will stand in the balcony of the main public banking room, one on either side, and will have 16 in. marble dials.

A vacuum cleaning system which reaches every room in the building and is, of course, electrically operated, is automatically controlled by a solenoid switch from sixteen 3-way, momentary contact, lock switches placed at different points in the building which start and stop the motor in the sub-basement.

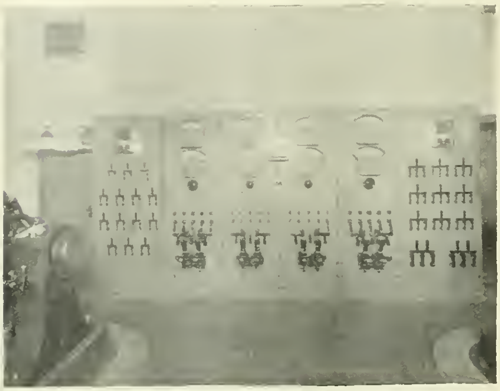


Fig. 4—Handsome switchboard of Tennessee marble

All the wiring has been done in conduit. The switches used throughout are the Metropolitan movable mechanism switch. The conduit was supplied by the Conduits Company, Limited. The necessary condulets were supplied by the Crouse-Hinds Company. The wire was supplied by the Hebershaw Wire Company, New York; the base receptacles by the Bryant, Chapman Company; the floor receptacles by Thomas & Betts; the annunciators by Edwards, New York; clocks by the E. Howard Clock Company, New York.

As representing the general use to which motors can be put in an installation of this type, the following list representing an approximate total of 100 h.p. is interesting. Two 10 h.p. motors are used to expel the hot air from the basement (the heating system is a combination, hot air and hot water); one 4 h.p. motor operates a fan at the fresh air inlet; one 10 h.p. motor drives the vacuum cleaner; one 10 h.p. motor supplies compressed air for the pneumatic tubes connecting the offices throughout the building through the central room spoken of above; one 10 h.p. motor circulates water for drinking purposes; two 10 h.p. motors are situated on the roof for operating the ventilating exhaust fans; two 3 h.p. motors operate in connection with sewage disposal; one 7½ h.p. motor operates a book lift; one 7½ h.p. operates a dumb waiter; one 7½ h.p. sprays water in the air washing room; one 10 h.p. motor operates a vacuum equipment for use with the elevators in emergency; one two h.p. motor drives a motor blast fan in the incinerator.

The work of installing the wiring equipment has been carried out by the Harry Alexander Company of New York and Toronto. This office, situated in the new Bank of Toronto Building, is under the supervision of J. M. Lindsay, as manager, and the installation itself was done under the personal supervision of Mr. H. Rohleder, superintendent of construction for the Harry Alexander Company.

Perhaps the most noticeable feature in connection with the electrical installations in this new bank however, are the lighting fixtures. These are being supplied and installed by the Murray-Kay Company of Toronto. A number of photographs of the beautiful fixtures used in this installation are shown herewith. At the entrance of the vestibule on either side of the doorways will be placed two beautiful six-light standards as shown in Fig. 1. These standards are of solid bronze, the detail on the shaft being all hand chased. The centre of the main banking room which occupies, in height, the first two floors is lighted by four 60-light electroliers which are probably the finest fixtures that have yet been installed in any Canadian public building. This is a semi-indirect fixture, the centre bowl being of alabaster specially carved and imported direct from Italy for this bank. All metal used in the fixture is of bronze, hand-chased and finished in real gold. Some idea of the magnificence and cost of these fixtures may be gathered from the dimensions; the diameter of the alabaster bowl alone is 3 ft. 6 in., while the diameter of the metal crown supporting the bowl is 5 ft. The height from the bottom of the fixture to the crown is 15 ft. 6 in., Fig. 5.

Fig. 5—Main banking room fixture, 15 ft. in height.

The main banking room is completely surrounded at the second floor level by a balcony or mezzanine floor which is lighted with eighteen 6-light ceiling fixtures finished also in real gold. A reproduction of this fixture is shown in Fig. 7. The bowl is of alabaster also specially imported. The re-

Fig. 6—Private offices

Fig. 7—Balcony

Fig. 8—Assembly room

Fig. 9—Exterior view new head office building, Bank of Toronto, Toronto

sultant effect in this room both from an artistic and an illumination point of view is satisfactory in the extreme.

In the officers' rooms hand-carved wood fixtures are used, the finish being applied in real gold leaf. The high lights are brought out in a polished finish with the receding details in a dull gold, a combination of shades which greatly enhances the beauty of the fixture. The assembly room is lighted by four 5-light bronze fixtures finished in Vernis gilt. Every part of these fixtures is cast and hand tooled.

The entire lighting scheme is in accordance with the classical detail of the interior of the building and is certainly a marvel of design and execution which in its effect fully justifies the careful attention given by the architects to this building.

Successful Rejuvenation

The Jovians of Toronto held another rejuvenation on April 4th, which, as shown by the enthusiesm, was one of the most successful rejuvenations ever held in this city. Though barely two months since the last initiation ceremony was performed, thirty new candidates presented themselves for membership in this order. Included in these were a number from out of town who showed splendid promise of becoming enthusiastic jovians and who will now begin organizing leagues in their own cities throughout the province of Ontario.

Toronto Jovians pride themselves on the elaborate manner in which the initiation proceedings are carried out. The combination of a perfect Degree Team supplemented by Reigning Jupiter Frank E. Watts, jovian scenery and electrical effects made this rejuvenation more realistic than ever. One of the hits of the evening was when all the White Ball candidates were presented with hats similar to those worn by Dutch comedians. The galaxy of colors and the expressions on the candidates' faces, caused much merriment.

The Degree Team consisted of the following:—Reigning Jupiter, Frank E. Watts; Neptune, B. O. Saltern; Vulcan, W. F. Wright; Hercules, Ed. Malloy; Mars, A. K. Johnston; Pluto, Claude Warrington; Mercury, J. F. Ward; Aurenim, G. M. Scott; Apollo, H. C. Brown; Imps, J. R. Stacey, M. Culligan, H. S. Brown, H. A. Beach.

After the rejuvenation, a Joviation was held in the way of an electrical lunch at which there were sixty-five old jovians and thirty new ones. Music was interspersed with several interesting talks. The speakers included Mr. Chas. H. Dudley, Mr. R. E. T. Pringle, and Mr. D. H. McDougall. Statesman E. B. Pike was responsible in no small measure for the success of the evening. Arrangements are already being made for a midsummer rejuvenation to be held in the open air on the lake shore.

Jovian Notes

Statesman Bennett is arranging for a rejuvenation to be held in Montreal on the 19th inst.

The Jovian Luncheons in Toronto are well attended and some interesting addresses have been given. Statesman Pike desires to have the addresses of all Jovians in the district, to assist him in revising his mailing list.

Better Be Late Than Never

The Fort Wayne and Northern Indiana Traction Company has entered actively on an accident prevention campaign and is advertising widely in the daily and weekly press, the advertising taking the form of talks. It is said these talks appear in more than 30,000 newspapers which cover a local population of about 200,000 people. The following "talk" is typical of the series being run by this company.

"For a safe and sane everyday.

"The serious injury or death of a human being in a railway accident calls forth the keenest sympathy of the public and all connected with this company. A careful study of the past records has shown us that practically all accidents are avoidable if everyone thinks before he acts and thinks of safety first. Co-operation will do this where everything in the past has failed in part at least. All you have to do to join this safety movement is to

"Think,
"Never take any chance,
"Get the safety habit,
"Set the safety example—daily."

The Corporation of Megantic, P.Q., have retained the services of Mr. Edward A. Evans, Mem. Can. S. C. E., to prepare a hydro-electric plant for the commercial lighting and power required for the town. It is probable that the dam will be about 65 feet in height.

Toronto Sons of Jove—One hundred members making merry at an Electrical Luncheon

Important Problems in Telephone Work

Electrical Interference Between High Tension Circuits and Telephone Circuits—The Remedy in Theory and Practice

By Mr. C. A. Buckard

The problem of electrical interference between high tension circuits adjacent and parallel to telephone circuits producing disturbing influences in the telephone system, present an important problem to both the power engineer and the telephone engineer.

The problem is not a simple one and each individual exposure between high tension circuits and telephone circuits requires special treatment although general lines of procedure towards remedying the trouble can be followed. With proper co-operation between the power engineer and the telephone engineer and a certain degree of fairness exercised by both, the troubles caused can usually be eliminated to a satisfactory degree without undue expense to either of the interests involved.

It has long been clearly understood that an electric circuit transmits energy not through the body of its conductors, except to an almost negligible extent, but through the dielectric surrounding the circuit. The conductors are but a guide for energy in its course of transmission through the dielectric. The extent of surrounding dielectric which is energized is known to depend on the voltage, power and electrical constants of the circuit and the geometric disposition of the conductors in a plane perpendicular to the circuit. Modern electrical theory assumes fields of electromagnetic and electrostatic force, as a means of explaining the nature in which the dielectric is energized and also the phenomena of induction. If a foreign electrical conductor lies in these fields of force, any change in the intensity of these fields introduces a voltage or current in the conductor; these being the effects of the phenomena of induction either electromagnetic or electrostatic depending on the kind of field of force in which the conductor lies. Therefore when a telephone system exists in parallel proximity to high voltage or high power alternating current transmission systems there is usually interference in the telephone circuits.

Interference between high tension circuits and telephone circuits is of three fundamental kinds, i.e., telephone circuits parallel and adjacent to a high tension circuit are subject to effects due to electrostatic induction, electromagnetic induction, and leakage. These effects are not separate and independent, but are often mingled in an intricate and confusing way and manifest themselves usually as noise in the telephone receiver.

Under particularly favorable conditions and with all the factors known, mathematical calculations of the induced current are possible. These formulae, however, are not of great value in practice as they neglect insulation conditions of the circuit involved, and it is very difficult to get accurate enough basic data of line characteristics to justify the detail calculations.

Further development of formulae could probably be made for the various combinations of alternating current power circuits and telephone circuits under conditions which might be more or less realized in practice but as soon as one has to deal with more than three or four conductors the formulae become very complicated and are practically unmanageable. Mathematical solutions wholly, involve calculations of capacity and inductance. For telephone circuits this would mean the calculations of split capacities and inductances, that is to say, the capacities and inductances of phantom circuits, and these depend more or less on assumptions as to conductivity of the earth, etc., not actually realized and which are really unknown quantities unless measured. In actual practice we leave such calculations of complex circuits to those who delight more in mathematical exercises than in experimental determinations of values.

While usually none of the factors which tend to produce noise current in the telephone circuit occur separately, it is possible to develop methods of remedying the different factors by considering the effects of each individually.

In general, interference with telephone circuits from direct current circuits is nil except in the case of leakage from the direct current system. This manifests itself usually as electrolysis of the telephone plant, mostly of the cables, and seldom causes trouble in the telephone circuit except that of a complete breakdown of all circuits when the electrolysis has eaten the lead sheath of the cable and moisture has entered the paper insulation.

Direct leakage from alternating current circuits to telephone circuits is difficult to prove except by seeing actual contact, but frequently, from experience, it seems the only reasonable solution of the intensity and potential of the foreign current which is sometimes flowing in the telephone circuit. Poor construction and low insulation, broken insulators, line wires accidently grounded by guys, trees touching power wires, all coupled with similar conditions in the telephone system make such a condition possible. This condition has existed and has been remedied at considerable expense, by overhauling whole telephone plants. It has caused

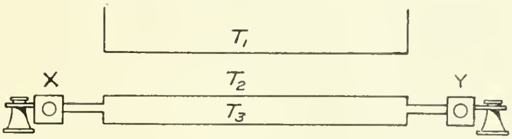


Fig. 1

telephone companies affected to carry a much higher grade of maintenance than would be necessary if a similar high grade of construction was used by the power company. If leakage, i.e., low insulation, exists only on either the telephone circuits or the power circuits alone, the interference is of an inductive nature.

When considering the effects due to induction, whether electromagnetic or electrostatic, one must bear in mind that the whole science of having a perfectly quiet telephone line in a foreign electromagnetic or electrostatic field is dependent on the Wheatstone Bridge principle, that no current will flow in the wire or instrument connecting two points at the same potential even though these two points are on conductors of considerable magnitude. The practical application of this principle requires that each wire of a telephone circuit shall have the same resistance, the same inductance, the same capacity and the same insulation resistance, and more exactly that these conditions of equality shall hold not only for the circuit as a whole, but for each and every short section of circuit. In practice these ideal conditions can be obtained only approximately, but sufficiently balanced conditions can be obtained to make the great majority of the telephone lines commercial.

Electrostatic induction manifests itself both as current in the telephone circuit and as voltage between the telephone circuit and the earth. In Fig. 1 T_1 is a power or high ten-

sion circuit. It will induce in the telephone wire T_2 a certain charge, of a potential greater than a similar charge which it will induce in the telephone wire T_3. The differences in charges is due to difference in electrostatic capacity, it being assumed that one wire is farther away from the power circuit than the other, which is the usual condition. Immediately a difference of potential exists in the circuit through the telephone instruments X and Y, and a current will flow attempting to equalize this difference of potential. As the alternating voltage of the power circuit goes through its cycle, so will an induced current in the telephone circuit go through a corresponding cycle, and theoretically 180 deg. in phase displacement from the primary voltage. Without

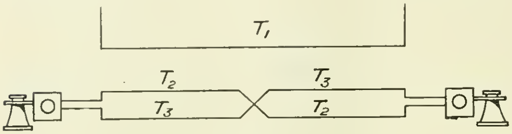


Fig. 2

going into the theory of transposition, if the mutual relation of the telephone circuits and the power circuits is changed, that is to say, if the telephone circuit is transposed against the power circuit at the centre of the exposure (Fig. 2) the current induced will be reduced to one-half its former value. Theoretically this process may be continued until the foreign current flowing through the telephone is so small that it is negligible. Sometimes when conditions are extremely unfavorable it is physically impossible to introduce sufficient transpositions to reduce the induced current to such a point that a commercially quiet circuit is obtained.

Between the power circuit of Fig. 1 and the ground there exists a potential depending on the method of operation of the power circuits, that is to say, whether one, two or three phase with or without a grounded neutral. According to the theory of equi-potential planes the conductors of the telephone circuit would lay one in one plane and the other in a second plane or perhaps both in the same plane, the exact potential of each conductor above the ground being determined by its mutual capacity with the power circuit and the ground capacity of each wire of the telephone circuit. The potential above the ground which is induced will not cause a serious induced current in the telephone circuit, provided the insulation of the telephone circuit is balanced and the inductance and capacity to ground is balanced and the circuit is transposed properly against the high tension circuit. However, if one wire of the telephone circuit is of low insulation an alternating current will flow, as a difference of potential will exist between the sides of the telephone circuit depending on the leak to ground through the low insulation. This latter fault causes probably a greater portion of the noise current in parallel adjacent telephone lines and power lines than is generally supposed.

It frequently happens that the telephone line adjacent to the high tension line is quiet, that is, it is perfectly balanced, but when this is switched to another telephone circuit which is unbalanced the connection becomes noisy. However, the unbalance in the connecting telephone circuit is not serious for the normal operation of that circuit by itself as this circuit does not lie in the field of disturbance. To illustrate, in Fig 3 we have a power line T_1 and a telephone circuit T_2, T_3, the exposure between the power circuit and the telephone circuit being only a short portion of the total length of the telephone circuit or connection. Some miles distant at a point G, there is a high resistance ground, that is, low insulation on the wire T_3, causing an unbalanced condition of insulation on the circuit as a whole and hence causing a current flow. These leaks may consist of slight tree grounds, careless bridling of run offs, etc. This sort of trouble may be remedied at the sacrifice of efficiency of telephone transmission by increasing the insulation of the exposed portion, and isolating this portion of the telephone circuit with one to one ratio transformers. In telephone practice these are called repeating coils.

In the preceding, attention has been paid to insulation unbalance, but capacity unbalance gives similar trouble and is experienced sometimes in cables, especially in connection with phantom circuits, a description of which is given later.

For ordinary operation, away from a foreign field of force, considerable unbalance can exist in the telephone circuit and yet service can be given. When a telephone circuit, however, is in parallel proximity to a foreign circuit, these unbalances give trouble and particularly so when these foreign circuits are of a high potential. When a telephone circuit has been finally obtained which is quiet in the vicinity of a power circuit it is in a state of unstable equilibrium as so many slight and unavoidable causes will effect its balance. This condition causes the ones responsible for the telephone circuit to pay particular attention to these circuits and increases the cost of maintenance greatly.

In the preceding, attention has been paid to effects of balance or unbalance in the telephone plant when operating in the vicinity of a power circuit. Suppose under normal operation of the power circuit, with balanced load and insulation, we have obtained a quiet telephone circuit. If anything occurs to unbalance the electrostatic field surrounding the power circuit such as to increase the intensity of that field, the effects are almost immediately felt in the telephone system.

In high tension systems not employing a permanent ground at some portion of their circuit, such as a grounded neutral, any condition of low insulation on any one of the line wires causes practically full line voltage to exist between the other wires of the circuit and the earth. Slight tree grounds, punctured, broken or cracked insulators will cause this. In polyphase circuits unbalanced load conditions will also cause this. As the induced current is increased in proportion to the intensity of the electrostatic field, the telephone circuit perhaps becomes uncommercial wherein sufficient transpositions have been previously introduced such that under normal operation of the power circuit the telephone circuit is quiet. Or perhaps the earth potential of the

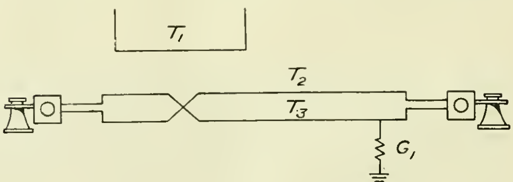


Fig. 3

telephone circuit which under normal operation of the power circuit is permissible, mounts up to sufficient values to operate the protectors in the telephone circuit grounding perhaps one side of the line. When normal conditions again prevail in the power circuit the telephone circuit remains noisy until this ground is found and removed. Thus the telephone circuit may be out of commission a much longer time than the power circuit which has caused the trouble.

While it is realized that any power line is liable to trouble, reliability of service demands that there be a minimum of trouble on the lines. Notwithstanding this there are operating comparatively high tension transmission systems of old type of construction which get into trouble so frequently, and operate under such frequently changing load

conditions that it is almost impossible to give satisfactory telephone service in their vicinity.

Electromagnetic induction from power circuits to telephone circuits under certain conditions is a serious disturbing factor in the operation of the telephone circuits. Theoretically a voltage induced in a telephone circuit from a parallel power circuit by electromagnetic induction, can be eliminated by a single transposition introduced into the telephone circuit at the middle of the exposure. Considering the laws of electromagnetic induction this can be seen by an examination of Fig. 2. The potential in the portion of the circuit on one side of the transposition will be equal and opposite to the potential on the other side of the transposition, thus neutralizing each other.

It sometimes happens where the power circuit makes use of a ground return, such as a single phase railway or a transmission system employing a grounded neutral through which a strong current flows, that a serious earth potential is introduced in the telephone system due to electromagnetic induction giving rise to effects similar to those described where an earth potential exists due to electrostatic induction. In cases like these, with the exception of a single phase railway, it would appear that it is the duty of the power company to change conditions in their plant such that an earth current does not flow, or else use some means to reduce the extent of the electromagnetic field.

In polyphase circuits employing a grounded neutral, at both the generating and receiving end of the line unbalanced load conditions cause a current flow in the neutral circuit. The obvious remedy is to balance the load which will overcome the difficulty or remove the ground from the neutral. This latter procedure may give rise to increased unbalanced electrostatic conditions which might give trouble. In three-phase circuits employing a grounded neutral an important factor is the well-known fact that the third harmonic of the impressed e.m.f. of the power circuit exists in the circuit of the grounded neutral and possibly the ninth harmonic and still higher harmonics. Induced current of low frequency in telephone circuits, such as frequencies of 25 cycles or under, are not as annoying in the telephone circuit as current of higher frequency. Probably the noise of an induced current of 25 cycles would not be noticed by an ordinary telephone subscriber, but any noise from a current of frequency above this would begin to be noticed. From a three-phase system of 25 cycles with a grounded neutral the frequency of the induced current might be 75 cycles or 225 cycles, the noise from which would be distinctly audible. By listening to the pitch of the tone in the telephone receiver connected to the exposed circuit it is often possible to obtain considerable evidence as to the importance of the neutral ground when investigating trouble due to exposures between three phase circuits and telephone circuits.

Certain three-phase high tension transmission systems, by use of the neutral ground make use of the earth as a conductor where a cheap type of plant is wanted, causing a very bad unbalance both electromagnetic and electrostatic. It would seem that this practice in comparatively thickly settled communities should not be allowed as it puts an unreasonable burden on the companies which exist for the transmission of intelligence and who should not be forced to put up an expensive type of construction in order to operate, on account of the extremely cheap method of construction which may be employed by the company which exists for the transmission of power.

Where it is not possible for the power company to take such steps in constructing their plant, to remove dangerous or disagreeable voltages from the telephone lines due to the method of operation of the power company, there is a method of reducing earth potentials in telephone conductors by a compensator. This is not especially desirable and has serious objections. A compensator is a transformer with windings of such a ratio that when the secondary or secondaries are connected to the telephone circuits the voltage from it is equal and opposite to the voltage induced from the power circuit. A type of this apparatus has been used where the ratio between the primary and secondary windings is approximately unity, the primary being connected to one or more of the telephone circuits which were grounded through the neutral point of transformers. The locations of compensators in the telephone circuit have to be made as a result of special studies of load conditions in the power circuits. This procedure is now recognized as the best available practice when dealing with single phase railway exposures, but requires the use of extra conductors, the burden of expense of which may be considerable.

Another method of taking off potential to ground from telephone circuits is to ground the exposure portion of the circuit by drainage coils. This is a high impedance bridge with the middle point grounded. The connection is such that there is a high impedance path across the telephone circuit to the talking currents and a non-inductive path to ground for the induced or foreign current. This procedure is open to objection as it damages telephone transmission and the apparatus has to be protected with fuses and open space cut-outs which are somewhat difficult to maintain, and there is difficulty in getting good grounds especially in severe weather when a driven ground is liable to freeze. This method has been tried here in Canada with some success towards reducing the voltage to earth and reducing noise but the difficulties stated were experienced.

Other methods of reducing the induced current by reducing the extent and intensity of electrostatic and electromagnetic fields may be used, such as closing up the spacing of the power circuits or of the telephone circuits, or the running of ground wires close to and parallel to power or telephone circuit. The applicability of any of these schemes depend on conditions of exposure which are encountered and have to be the result of study and co-operation between the power and telephone engineers.

(To be continued.)

Telephones at the Coast

As indicating the extensive nature of the B.C. Telephone Company's development schemes in different parts of the province, it is interesting to note that in Vancouver during the past year or two, three suburban exchanges have been built, and this year the company will erect a six-storey building for headquarters for the plant department, and an eight-storey building to be used as head offices, and provide accommodation for three central exchanges to serve the district now looked after by the Seymour exchange. At New Westminster, extensive alterations are just being completed. A new cable has been placed across the Fraser and additional circuits strung in the section south of the river. In North Vancouver an estimate for more work has recently been approved. An exchange will be established at West Vancouver. In South Vancouver, a new building was recently completed at Collingwood, and a new exchange is to be erected at Fraser. Construction men will be busy in Point Grey this season. On Vancouver Island large expenditures have been made in Victoria, where a new exchange was occupied last year, but all the work laid out will not be completed for some time yet. In the district between Victoria and Nanaimo, equipment in all the exchanges has been improved. At Nanaimo, where the big cable will land, the city system has been made most modern. New toll circuits are being strung to Parksville. At Alberni a cut-over took place on March 1st. In the interior, Kamloops now enjoys the better facilities of a common battery exchange, and the

Nelson system is expanding rapidly, while an exchange will shortly be established at Kaslo.

Handy Soldering Device

Most of the outside plant men of the B.C. Telephone Company are in the habit of carrying small galvanized "cans" which have a slit in the top. This "can" is a simple soldering device, originated by local talent, and has been christened the B.C. Telephone Company's Soldering Torch, to distinguish it from inferior styles of torches made from tobacco cans.

The object of the torch is to provide a quick method of soldering and does away with the slow gasoline torch. A candle is used as the heating unit, and the splice to be soldered is laid across the slit in the top. The flame is applied directly to the splice and the soldering done on each side of the flame. The whole outfit costs only a few cents. It is six inches high by two and a-half inches wide, and one and a quarter inches thick. A drop from the top of a pole only serves to increase its usefulness.

Lineman using soldering outfit

The torch can be cleaned by taking out two small bolts and removing the lower part of the torch. Draught is scientifically provided for the candle which can burn undisturbed in a brisk gale owing to the can being windproof. It is hoped with the use of this device to eliminate loose connections which result so often in intermittent trouble. The soldering operation is simple, but its importance in giving the subscriber a perfect line being emphasized. It is pointed out that if care is take there will be few cases of trouble due to imperfect soldering.

Mr. Patterson, Vancouver drop foreman, for the B.C. Telephone Company, is the patentee, and is ready to explain his torch and back up the claims made for it. His men are using it and praising it highly.

Telephones in Forest Work

The forest branch of the Department of Lands for the province of British Columbia has just issued a report for the year ending December 31st, 1912, in which the use of telephones as a valuable auxiliary in forest preservation from fire is discussed. It is calculated that telephone lines could be strung at a comparatively small expense (from $30 to $80 per mile has been mentioned) and in conjunction with better roads would be the means of giving prompt assistance in the case of a fire outbreak which would often prevent the spread of forest fires. The report outlines a plan of trunk telephone lines and it is claimed that their construction will save money both in timber and in the number of men needed for patrol. To build these lines, which could be for the most part tree-lines, an expert telephone engineer will be employed to prepare plans and supervise the construction as it proceeds. The trunk lines as suggested aggregate approximately 1,000 miles of line. The report adds that as soon as weather permits, work will begin on field telephone lines to the extent of 175 miles.

Line Extensions

Development on Vancouver Island has demanded great activity on the part of the B.C. Telephone Company. Preparations are now under way for the extension of the company's system in the Oak Bay district, and also in the Victoria West and Equimalt section, Vancouver Island. A main feeder cable will be installed in Oak Bay, and a main feeder will also be placed to provide Victoria West and Esquimalt with better facilities. This work will be undertaken in the near future. Last year the company expended between $30-000 and $40,000 in Oak Bay so that telephone service might be provided the large number who had taken up homes in that district, but the growth has been so rapid that considerably more work is required. A construction gang is now at work on the toll line between Nanaimo and Parksville, and in a short time this new line, twenty-three miles in length, will be completed.

Personal

Mr. Geo. D. Leacock has been appointed manager of the Winnipeg office of the Packard Electric Company, Limited.

Mr. W. N. Warburton has been appointed general manager of the London & Lake Erie Railway and Transportation Company.

Mr. Patrick Dubee, secretary-treasurer Montreal Tramways Company, and president of the Canadian Street Railway Association is in England.

Mr. G. C. Murray, formerly of the Bell Telephone Company, London, has been appointed telephone inspector, Grand Trunk Railway Company, Stratford, Ont.

Mr. Arthur Skidmore has been appointed chief of the Grand Trunk power house at the Stratford shops, in succession to Mr. A. Kastella, who has been transferred to Ottawa.

Mr. S. B. Hammond who has been with the Porto Rico Railways in San Juan, Porto Rico, for the past two years has returned to Montreal to assume his new duties of secretary of the Montreal Engineering Company, Limited.

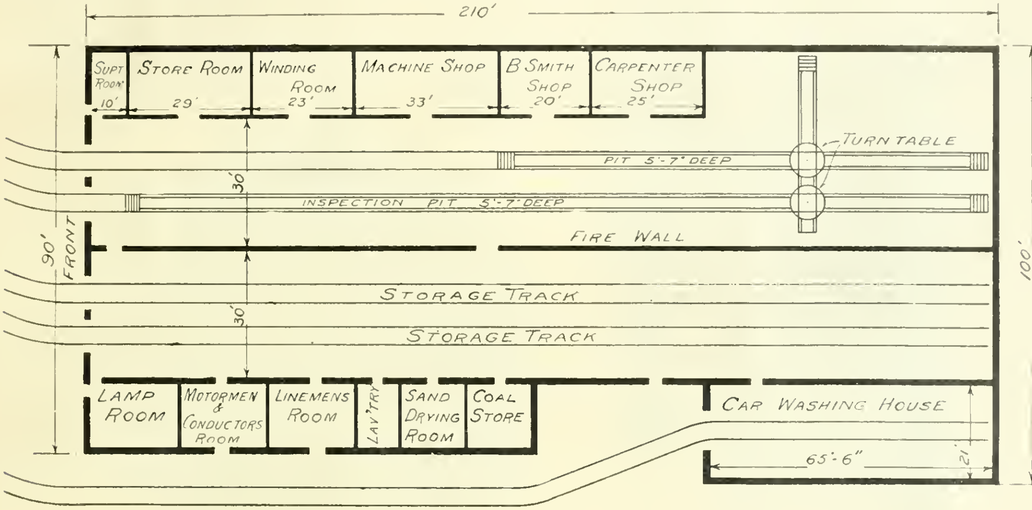
Mr. F. A. Gaby, chief engineer of the Hydro-electric Power Commision of Ontario, is in Europe on business connected with the extensive work to be carried on this summer in south-western Ontario. Mr. Gaby is accompanied by Mr. H. D. G. Crerar, one of the Commission's assistant engineers.

Mr. Charles Robbins who, since 1909, has been manager of the industrial and power department of the Westinghouse Electric & Manufacturing Company has been appointed assistant sales manager of this company with headquarters at East Pittsburgh. Mr. J. M. Curtin, assistant manager of the industrial and power department has been appointed manager.

ELECTRIC RAILWAYS

New Barns London & Lake Erie Railway Company

A recent issue of the Electrical News contained a description of the new car barns of the London & Lake Erie Railway Company and we are now able to reproduce a line drawing of the same. These car barns are located at St. Thomas which is about midway between the terminals of this road which operates between London and Port Stanley, a distance of some twenty-two miles. This line is now operated by power supplied by the Hydro-electric Power Commission of Ontario. The main car barn is 210 ft. x 95 ft., and the whole of this company's passenger rolling stock, namely, sixteen 55 ft. cars can be accommodated. As seen from the sketch the building has two pits, one the whole length and the other about half the length which enables easy inspection and repair of the car equipments. The general lay out of the barns with reference to offices, rooms, etc., can be seen from the accompanying sketch. Mr. W. N. Warburton has recently been appointed general manager of this company.



Sketch of floor plan of the London and Lake Erie Railway Company's new car barns

Relative Values of d. c. and a. c. Operation

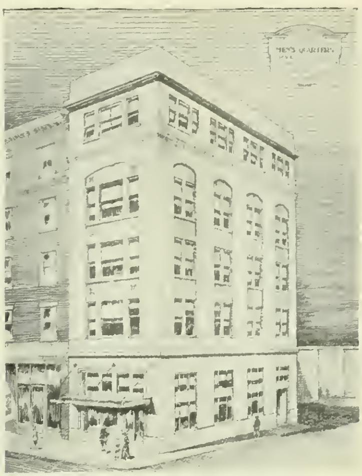
At a recent meeting of the New York railway club, Mr. Frank J. Sprague, of New York City, speaking on the relative merits of the various systems of high voltage a.c. and d.c. railway operation described briefly a number of features of his original Richmond equipment in 1889 and told of his early advocacy of direct current operation at 1,200 volts and higher. Referring to the old controversies about the merits of single-phase alternating current and direct current, Mr. Sprague said that too much had been expected of the former and too little attention had been paid to the possibilities of the latter in making use of higher line and motor voltages. The development of electric traction had now reached the point where one could specify the normal maxima in operating potentials on the working conductor at which there would be established a balance of advantages and disadvantages for any system. These potentials were about 6000 volts for polyphase operation, 11,000 to 15,000 volts for single-phase, 1200 to 1500 volts for direct-current with protected third-rail and from 2500 volts to 300 volts with direct-current trolley. There were inherent differences in the weights and costs of single-phase and direct-current motor equipments, when built and operated under like conditions of reliability, which were irremedial and which would be found in a large measure to offset whatever advantages might be achieved in efficiency of the secondary transmission. In view of the coming necessary interconnection of power supplies in which railroad use would be but one of many, and arbitrary cycle adoption for trunk-line operation was of questionable advisability. It was only after the inevitable development of each of the systems to its natural limit that any ultimate determination could be made regarding their relative values.

Referring to the idea of a Technical Commission who would make a study of the various systems of electrification as applied to any particular situation, Mr. Sprague said that much progress had been made. He felt justified in stating that the principal manufacturing companies were now favorably inclined to the creation of a technical commission to be composed of disinterested engineers of wide and varied experience who should make a thorough study of the various systems of electrification as applied to such situation or situations as might be taken up; that they were prepared to bear a part, or, if necessary, to meet the entire expense of such a commission; that they were in favor of some scheme of financial development which should relieve the railroads of part of the burden of raising capital, and finally that they awaited only the necessary co-operation of railroad officials to make effective this joint effort to avoid the heavy costs of mistakes due to individual judgment on the threshold of a great electrical development in transportation.

Building For Employees

The management of the British Columbia Electric Railway Company, Limited, have called for tenders for the construction of a building for the use of their motormen, conductors and shop employees who are stationed in Vancouver. The building will be located at the corner of Main and Prior streets, in the heart of the city and directly opposite the principal car barns in Vancouver and the repair shops maintained at that point. The block will be 25 feet by 60 feet in size, and five storeys in height. The type of construction will be of reinforced concrete with facings of brick and artificial stone. The estimated cost of the building is about $35,000.

There will be two entrances to the ground floor, one from Main street, and the other from Prior street. On the Main street frontage will be located the depot master's office and behind this, a large waiting room for the men. The entrance from Prior street is at the rear of the block, and leads to the elevator and stairways by means of which the upper storeys are reached. Above the ground floor the first floor will be used for lockers for the men, the second floor for a reading room, and the third floor for a billiard room, with room provided for one billiard and two pool tables. On the upper storey will be located the gymnasium for the men, the entire area of the floor being left clear for this purpose, and the room being 18 feet in height. The company will equip the gymnasium with a full outfit of apparatus. Lavatory accommodation will be provided on each floor, and shower baths are planned for the gymnasium. The entire building will be heated with hot water. Work will be started on the building at once, and it is planned to have it ready for use during the coming summer.



New Building for B. C. E. R. employees

Car Window Glazing

Who has not ridden in a street car and been annoyed by the ceaseless rattling of the glass in the side window sash, generally occurring, of course, in the city type of car? Glass set in putty is pretty sure to rattle in time unless the car and sash both are remarkably rigid in their construction and the roadbed is very smooth. The writer has experimented with several types of glazing and barring rubber, which is expensive and hardens with exposure to weather, no article of equal value has been discovered to the pleated or common felt. Felt lasts for many years, is inexpensive in the long run, costing about 12 cents for the average size glass, say 24 ins. by 28 ins., will readily fit any glass thickness from ordinary double thick to the heavy French plate, and can be used over and over again with only occasionally a lost piece. It cushions the blow when the sash are violently handled, either in raising or lowering, and also enables the glass to sustain a much greater blow without breaking than any other material. It can be used to reset a broken glass and the time consumed in the operation, where screw fastened beads are used, will only consume from 20 to 30 minutes, and anyone who has had to scrape and dig off putty from the sash of a putty-set glass, will readily see the saving; the latter operation frequently taking from one to two hours and then at a risk of badly bruising the sash. Assuming the labor cost to be 25 cents per hour, the time saved will pay for the felt used, to say nothing of the pleasure of having the car free from the disagreeable rattling and several degrees warmer also. On the road with which the writer is connected, the costs for glass alone were as follows:

In 1909, no felt used	$4.97 per car
In 1910, a little felt used	3.20 per car
In 1911, over one-half set in felt	2.96 per car
In 1912, all set in felt	1.06 per car

Weather conditions were very favorable in 1912, adding somewhat to the saving, but it is safe to assume that the saving in glass alone was over 50 per cent., while an even greater saving was, of course, made in the labor cost.

The felt used is about 1-16 in. thick, of a color to match the sash and is cut into strips 1¼ ins. wide, the length of a side of the glass. The ends of each strip are sharply pointed at each end, are laid over the perfectly clean rabbet in each, the glass pressed down firmly into place, the felt pressed down by beading screwed into place; then cut or trimmed close to beading with sharp knife. The felt, if properly installed, will never come out and there will never be a rattling glass, and when the latter becomes broken, on the removal of the beads, the sash is immediately ready for a new glass.—Electric Traction.

The Model Employer

At a meeting of the Labor Commission held in Vancouver during March, Mr. J. H. McVety, who appeared as the official mouthpiece of the B.C. Federation of Labor, paid a striking tribute to the B.C. Electric Railway Company declaring that the service both in the city and on the suburban lines had improved fully 100 per cent. within the last few years. Mr. McVety said that the motormen and conductors were satisfied with their hours and wages. Theirs was the model employer of all the street railway companies on the continent. The wages of the motormen and conductors ran from 24 cents per hour to 35 cents.

The executive committee of the Toronto branch of the Canadian Manufacturers' Association in a letter to the Mayor support the scheme of electric railway extensions on the local improvement plan as recently brought forward by Ald. Dr. Wickett. The letter states that the committee is of the opinion that a well planned general scheme of transportation lines administered by a board free from sectional or political influence, might be put into effect with advantage by assessing the cost of constructing the lines, in whole or in part, against the property benefitted and suggest that the council take an early opportunity of seeking the necessary legislative powers to carry this scheme to completion.

It is said that the engineers who will make a survey of the lines of the St. John Suburban Railway Company will commence work at once.

Illumination

Semi-Indirect Units

The favor with which semi-direct lighting is meeting both for commercial and artistic illumination, has led to a multiplicity of shapes and designs in translucent shallow bowls and placques. Such bowls and placques are designed to harmonize both in shape and in exterior elaboration with the in-

Haskins-Lucida Renaissance design semi-indirect bowl

terior finish of the building in which they are used. The variation in design is limited, in fact, only by the willingness of the glass manufacturer to provide the costly molds in which the bowls are made. The accompanying illustration shows a side and bottom view of a new Haskins-Lucida semi-indirect bowl of "Renaissance" design. The shapes shown are typical of the translucent semi-indirect bowl, though the design is more intricate and elaborate than common. The bowl is 20 in. in diameter and approximately 8 in. deep.

The Toronto Electric Light Company has filed plans at the City Hall for an extensive underground system. The plans call for a net work of underground wires in the district bounded by Spadina, Bay, Sherbourne and Wellesley and St. Albans on the north.

The "Nulite" Tungsten Sign Lamp

The Canadian Tungsten Lamp Company, of Hamilton, Ont., have recently put a 12 volt, 5 watt sign lamp on the market and the sales department of the above company state that it has met with immediate approval and that the quantity on order is proof of the merit of this style of lamp for sign advertising work. The lamp is illustrated herewith. The saving these lamps effect should interest everyone who uses an electric sign, for considering that they give from

two to four candle power more light than the carbon lamps, at one-third the operating cost, it is reasonable to expect all overhead signs soon to be equipped with this class of lamp. Fragility is overcome by the use of drawn wire filament, which allows these lamps to stand unlimited vibration and set in any position under the most trying conditions. The company have given their lamps the name "Nulite," as representing a new era in sign illumination.

Esterline "Golden Glow" Lamps

The Esterline Company, LaFayette, Indiana, who have been making a successful line of glass reflector type fog penetrating lamps for marine service, familiarly known as the "Golden Glow" lamps, has recently announced a line of similar construction for electric railways and steam and mining locomotive service. The design and construction of these lamps differ radically from other existing types, in that the reflector, instead of being a metallic or enamelled surface, as commonly used in most lamps, consists of a molded plate glass parabola, ground accurately to size and shape, then polished and silvered like a French plate mirror. The glass, by a secret process, is given a greenish-yellow color which is about the color of molten gold, hence the name "Golden Glow." A golden-yellow light will penetrate fog and mist to

a much greater degree than will a white light, and many recent tests on the great lakes and the sea coast, show that Golden Glow lamps have wonderful penetrative power. The use of the Golden Glow reflector also renders the light from the lamp much less dazzling since it removes the actinic rays from the light, rendering it soft and mellow. Experience shows that, not only is the light much less dazzling to pedestrians, but it is also less fatiguing to the motorman

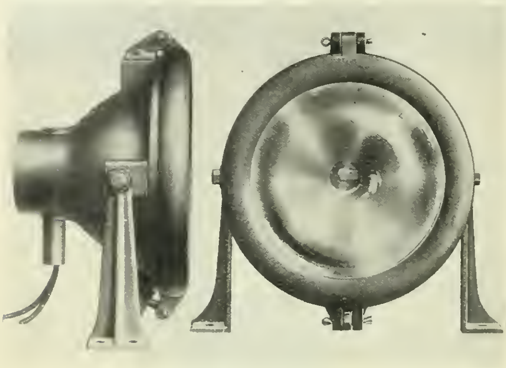


Fig. 1

or the engineer who is driving by it. The reflectors of the lamps, being made of glass, will never tarnish, but retain their lustre indefinitely. They can be cleaned without the possibility of harming or scratching the reflecting surface.

The Golden Glow lamps for street railway, interurban, electric and steam locomotive service are built in two types. In Fig. 1 is illustrated the hood type lamp, designed for mounting on top of the car or locomotive. The dash type of lamp, in which a part of the lamp is recessed into the surface on which it is mounted, is illustrated in Fig. 2. The housings for the reflectors are of metal, and the glass para-

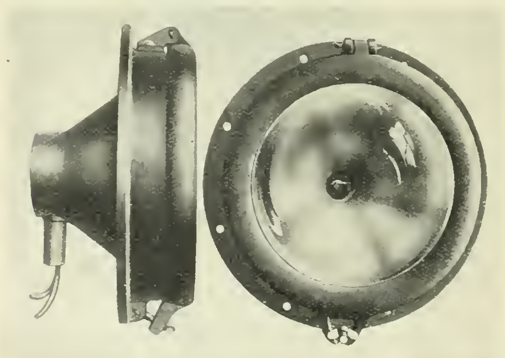


Fig. 2

bola is securely held in place. The illustrations show the lamps with the bulbs removed. A standard spherical incandescent bulb is used with a standard Edison base. The sockets for the bulbs have a large, heavy porcelain support which serves to thoroughly insulate the lamp. The reflector, being of glass instead of metal, also reduces the possibility of grounds or short circuits. The front, or door, of the lamp is hinged at the top. The upper hinge is made adjustable, so that all play can be taken up and the front cover pressed tight against a gasket, rendering the lamp practically water and dust tight. The front glass is held in by means of spring clips which, while they hold the glass securely in place, distribute the strain in such a manner as to render cracking of the glass very remote. The lower clamp for the cover is of the thumb screw type with the screw turned back in order to keep it out of the way. In the design of the lamp, all unnecessary projections have been omitted.

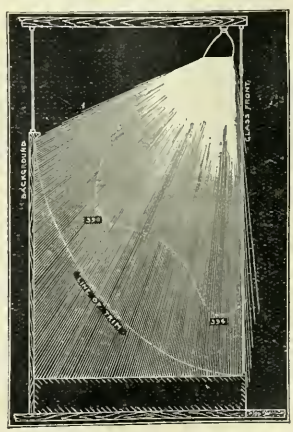
The lamp body is ventilated in such a manner that while water and dust cannot enter, it permits of a ready dissipation of the heat, so the lamps will not sweat.

The 'Visor' Reflector

The X-Ray Visor reflector, Fig. 1, is the fourth of the exclusive line of X-ray opaque mirror reflectors designed ing the Helmet, the Scoop and the Poke Bonnet. There are solely by the National X-Ray Reflector Company for efficient and uniform store window lighting, the other three being the Helmet, the Scoop and the Poke Bonnet. There are so many store windows nowadays having comparatively low backgrounds, or backgrounds of transparent glass, or no background at all, that two additional requirements for scien-

The Visor Reflector

tific window illumination had to be met. The first was the problem of concealing the lamp from the passerby and onlookers in front of the window, and also from the people inside the store. Second, there must be no reflection of the glare of the lamp visible from the street, as this would seriously mar the attractive stage lighting effect. That is to say, a bright uniform light from hidden sources. The Visor

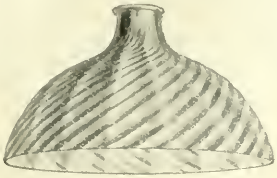


Distribution of Light by Visor

reflector is claimed to meet all these requirements. It prevents light being wasted by passing over the background into the store, it hides the lamp from the ordinary range of vision completely, and covers the lamp in such a way that

its reflection cannot be seen in the glass or polished background of the window. It is designed for use with 60 or 100 watt mazda lamps and uses a 2¼-in. "Form H" holder. The dimensions are, depth, front to back, 10 5/8 inches; width 9½ inches; height 8 9/16 inches.

The X-Ray line of direct lighting reflectors for use in warehouses, factories, shops, over-counters, over special ma



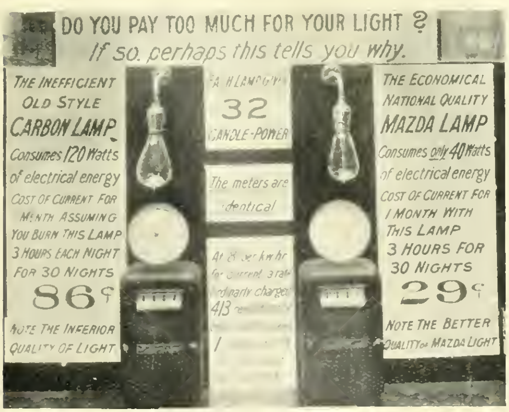
Concentrating Type Reflector

chinery, etc., has also been augmented by the addition of a new type of reflector, No. 710. Number 710 is a concentrating type of reflector and is used with 60 and 100 watt lamps. It will not take a 150 watt lamp, and the standard "Form 0" holder is used. Its dimensions are as follows: diameter 11½ inches; height 6¾ inches; holder 2¼ inches.

Good Advertising

The Sunbeam Lamp Company are distributing a little booklet entitled "Mazda Means Electric Light For Everybody" and are following these up by furnishing the various dealers throughout Canada with attractive window display cards and demonstrating machines. A reproduction of one of the demonstration ideas is given herewith. This is a two meter board display which demonstrates the practical economy of mazda lamps. The hand on the pan above the meter is turned by a vertical shaft from the meter disc and by its more rapid movement shows very clearly which meter is registering more current. The explanatory matter on this board display further emphasizes the great difference in current consumption with carbon and with mazda lamps.

Another demonstrating machine shows what is called a triangular dome bump test. This dome is made of plate glass and has illuminated advertising copy. The dome is revolved by means of a shaft and as it revolves tilts back



and forth by means of a track upon which the dome is run. At one point on the track the dome falls about 12 in. and to the bystander it looks as though the whole outfit would be knocked to pieces. That the lamps take no harm greatly emphasizes their durable qualities.

Another machine represents "The Weighing of Carbons and Mazdas." One scale pan of a balance contains three carbon lamps and the other, one mazda lamp. The pans are automatically kept tilting and the pointer, moving to right or left indicates either the word "waste" or "economy" depending on whether the carbon or the mazda pan is down. By a further automatic arrangement, sixteen pieces of advertising copy also appear in consecutive order.

New Books

Elevators, Electric & Hydraulic—By C. F. Swingle, M.E., F. J. Drake & Company, publishers. Price $1 net. Literature treating upon the subject of elevators, either electric or hydraulic, is very rare. This volume has been prepared, therefore, with a view to assisting the engineer who is responsible for their care and the operators whose duty it is to handle elevators. The principles involved in the construction and operation of the various types of elevators are clearly set forth. The illustrations are such as to assist greatly in the understanding of the text and in making the operation of elevators evident to the untechnical reader.

Self-contained Motors—Pamphlet No. 16B issued by Bruce, Peebles & Company, Limited, on the subject of self-contained polyphase induction motors. The pamphlet contains a very full specification of the motors together with illustrations of various parts and of some of the different types of motor. In addition, outline illustrations and full lists of approximate weights and dimensions of every size manufactured by this company are given, as well as full lists of technical data for 50 and 25-cycle motors, machines being dealt with for three separate ranges of voltage from 110 volts up to 3,500 volts at speeds from 150 up to 1,500 r.p.m.

Transmission Line Formulae—By H. B. Dwight, B.Sc., Associate A. I. E. E.; D. Van Nostrand Company, publishers. Price $2 net. The object of this book is to compile a set of instructions for engineers which will enable them to make electrical calculations for transmission lines with the least possible amount of work. The chart and working formulae have for the most part been developed independently by the author. The second part of the book is for reference chiefly and contains the derivation of the principal formulae used in connection with transmission lines. It is stated in the preface that as many recent articles on transmission lines make use of formulae which are only roughly approximate, a reliable collection of formulae with the method of obtaining them should be found valuable.

Electric Meters—By Cyril M. Jansky, B.S., B.A., associate professor electrical engineering, University of Wisconsin. The McGraw Hill Book Company, New York, publishers. Price $2.50 net. This is a book which treats, in a comprehensive and systematic way, the various kinds of electrical measuring instruments. The descriptions apply chiefly to instruments manufactured in the United States. In the classification of these instruments the main divisions have been made in accordance with the quantities to be measured and minor sub-divisions according to the principles of operation. Although such a classification has necessitated some repetition in describing the different instruments whose operation is based on the same principles, still, for the sake of clearness and simplicity, such a classification appears justifiable. A successful attempt has been made to explain the fundamental principles in a general way and for this reason many line drawings and vector diagrams are used. The manner in which these fundamental principles are applied in practice is usually exemplified by means of cuts of the actual instruments. The book is splendidly printed and illustrated throughout and we believe, constitutes the best treatment of the subject of electric measuring instruments that has appeared to date.

The Dealer and Contractor

The Electrical Contractor as a Credit Risk

Opinions on the subject of the standing of electrical contractors and their value as credit risks, have been solicited by the National Electrical Contractor and the following notes by Mr. R. G. Littler, we believe, covers the situation as very generally existing. Mr. Littler's remarks bear out the statements recently made in the Electrical News regarding the necessity that electrical contractors pay more attention to the business end of their system and especially to that of the all-important overhead expense.

The subject of this discussion is one requiring a great deal of careful thought if it is to bring out suggestions which will be of benefit to our readers, and to all those interested in placing the electrical contractor on a basis where he really would be considered a good credit risk.

The first point which comes to the mind of the writer is: The reason or reasons why, the electrical contractor (generally speaking), is considered a poor risk and slow in paying his accounts. In the first place, let us follow the "rosy" path of the "average" contractor, from the time he begins business, until he is either swamped by a land-slide of creditors, or else becomes, in a measure, a responsible business man, looked upon as really desirable by those from whom he does most of his purchasing. In the former class, statistics tell us that approximately 95 per cent. of electrical contractors are listed, leaving the magnificent balance of 5 per cent. as fairly successful in the line of business which they have selected as a livelihood.

In tracing the foot steps of the average contractor from his birth into the business world, to his untimely death or ultimate success, I would proceed about as follows:

We have a journeyman wireman, and very frequently a budding apprentice, working for an apparently well-to-do contracting firm, probably for several years, and giving good and satisfactory service in return for his salary. He is probably living in the city suburbs, and a friend or neighbor is building one or more houses and takes the liberty of having the electrician next door give him a figure for wiring the houses. The electrician is finally permitted to wire the said houses during the evening when he has nothing else to do, probably having his regular helper assist him, after agreeing to pay him for his time at the regular wage scale.

He goes to the jobbing house where he has been in the habit of getting materials, probably every day for his employers, and puts the matter up to the manager, reminds him that he has been working for the Blank Elec. Co. for four years or so, and shows him that he is going to make $25.00 or $50.00 on the wiring of the houses, with the result that he easily gets credit for the materials until his neighbor pays for the work. He then proceeds to wire the houses, which he does in about one half the time that would have been consumed if he were doing the work for Blank & Co. and is finally paid for his work.

After settling up with his helper, and also with the jobbing house, he finds that he has made probably $30.00 by working four or five evenings in the week. He then sees how foolish he has been all these years, working for the other firm and thinks it is clear sailing. He goes to the jobber and arranges for further credit, (which, by the way), is the easiest part of the game and starts out bidding on all jobs which are within his ability to handle. He finally succeeds in landing several houses, probably a small apartment house or two, etc.

He then sees the business getting so large that he can no longer do all the work himself, and he hires three or four men, rents a shop and goes at things, as he thinks, in a business-like manner.

From this time on the overhead expenses of the business are piling up, unseen by the new proprietor, who only realizes the accounts due him and does not take the trouble to realize the amounts he owes for supplies. In the course of time, his jobbing house sends for him and begins to inquire about the over due statements they have been sending. He successfully puts them off, however, until he makes "some collections" which seems to satisfy the jobber for the time being. The collections are finally made and the jobber gets probably 25 or 50 per cent. settlement, and the balance of the money collected goes into an automobile or some other equally valuable business asset.

Debts in Many Places

About this time, the contractor begins to patronize other jobbing houses, who are glad to receive a portion of his business, thinking they are putting one over on the original jobber. Things then go from bad to worse, the contractor becomes indebted to every jobber in town until finally some house files an attachment against his contracts and ties up his bank account (if he has one) and the thing is all over but the shouting. In the average case, the creditors get from 10 to 25 cents on the dollar, this particular contractor is no more, and the next contractor steps up to the bat, and the same thing happens all over again.

I have now dragged the contractor through the mire, and threshed the life out of him from every standpoint, but he is not entirely responsible, by any means for his downfall.

The jobber or jobbers who have been selling this man his materials have contributed considerably toward his destruction by being too lenient with him in the way of extending credit. The promiscuous giving of credit among jobbing houses which is nothing more or less than financing of contractors, is undoubtedly the cause of a great many failures in the contracting business.

Competition between the jobbers has become so keen that they are ready and willing to take a chance on a man and to finance his schemes, for fear that they will lose an account to a competitor, that may at some time in the future, be a valuable one. They probably start out by requiring the prospective contractor to pay cash for his purchases, which process finally results in the giving of credit to a certain limit, and this limit is gradually extended until the account grows to a dangerous size. It is this ease of being able to purchase materials on credit which enables so many to make a start into the electrical contracting game, and it

is the lack of credit information among the jobbers that causes the loss of so many accounts. Cases are not infrequent where as many as six or eight jobbing houses have filed claims on the failure of a single firm. This would be entirely uncalled for if the jobbers would forget their petty jealousies and have some medium of credit information among themselves. They should thoroughly investigate every new contractor who goes into business, as to his ability, honesty, previous record, etc., but the watchfulness should not stop at that point. The contractor should be watched as to how promptly he settles his bills, the class of contracts he takes, the economy he practices in his business and every day life, and such information should be made general property among the jobbers in the locality in which the contractor is doing business. The results of such an investigation and information would doubly repay those taking the trouble to make investigation, and would in time mean the establishment of a system which would be a widespread protection to the jobbing interests as well as to the contractors who are trying to run a legitimate business, and to those who are having contracting work done.

One of the best safeguards for the protection of the contracting interests, and which would mutually protect all those with whom the contractor deals, including the general public, is the Master Electricians License Law, such as has been passed in some of the States and has proved a great benefit to all concerned. This law, in a great measure, guarantees the fitness of an applicant for a State License to do electrical contracting, and makes him also more responsible financially than any thing could do under the present methods. Almost all states require the examination of barbers, plumbers, dentists, physicians, etc., and still allow any man who desires, to enter in to the electrical business, without the accounting to the State, as to his ability to perform the work whatever.

We have, now, as suggestions to make the Electrical Contractor a better credit risk, the following:

Co-operation among the jobbers themselves, including the distribution of credit and other information as given above.

More careful investigation of a proposed contractor, making the securing of credit more important than the mere asking.

Requiring the more prompt payment of accounts without fear of a competitor getting the business.

Securing the passage and operation of a Model State License Law for Master Electricians.

The Booth Felt Co.

The Booth Felt Company, Limited, has been incorporated by Mr. N. E. Booth, of Brooklyn, N.Y., to operate in Gananoque, Ontario. This company has acquired the Gibson property on Tanner street, Gananoque, and the plant is being put in shape for manufacturing a most complete line of felt goods for all mechanical and commercial uses. It covers felt washers, packings, lubricating pads, all kinds of dust and weather proofing strips, insulating materials, noise preventing typewriter pads, felt heel pads for shoes, wicks for fan motors and machinery, buffing and polishing wheels, hand blocks for rubbing and polishing, discs for electric light bulbs and many other specialties in the line of felt for manufacturers of machinery and mechanical appliances of every description. We understand the machines for this particular line of work have all been designed by and built specially for Mr. Booth.

The directors of the company are N. E. Booth, Brooklyn, N.Y.; E. W. Booth, Brooklyn, N.Y.; E. S. Sheppard, Gananoque, Ont.; B. A. Booth, Gananoque, Ont., and T. R. Brawley, Brooklyn, N.Y. Mr. E. S. Sheppard is secretary and general manager of the Canadian company.

The Largest D. C. Generators

The illustrations herewith represent what is claimed to be the largest capacity direct current generators ever built. They have just been installed in the plant of the Cleveland Electric Illuminating Company, and were manufactured by the Westinghouse Electric & Manufacturing Company.

These are two 3,750 kw., 275 volt, 180 r.p.m. shunt wound direct current generators driven by steam turbines through reduction gears with a 10 to 1 ratio. Fig. 1, taken while the machines were on test in the works, shows a workman of slightly above the average height in the foreground and gives

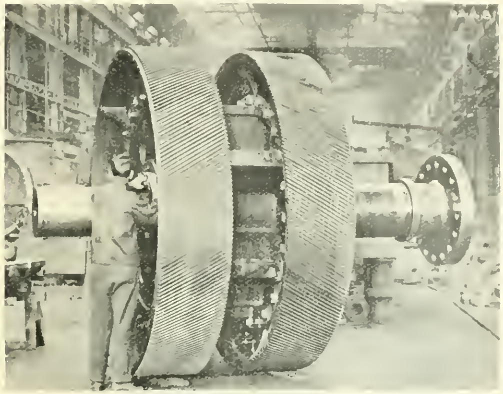


Fig. 1

one some idea of the dimensions of the machine. Each of these generators, entirely exclusive of the turbine and reduction gear, make six carloads during transportation. The armature was shipped on a flat car with the platform removed. The windings of the armature extended down to within four inches of the ballast on the railroad track. A sheet steel plate ⅜ inch thick, was placed beneath the armature to protect it from stones or any other projection on the road bed. Even with the armature at this level, there

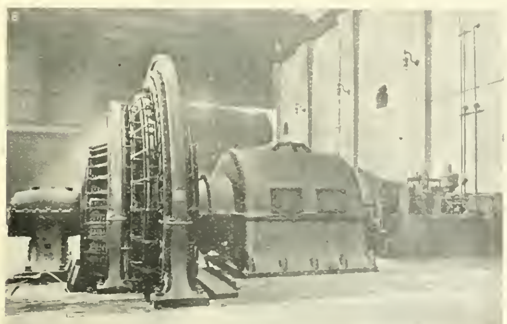


Fig. 2

was only one routing between East Pittsburgh and Cleveland where the clearance was sufficient to permit the armature to pass.

As it was impossible in the present state of the art to build a direct current generator of this size at a high speed, use has been made of the reduction gear which has achieved such an excellent reputation in marine work and is now being

extensively used in connection with d.c. generators and steam turbines. The large gear of this speed reducing mechanism shown in Fig. 2 is 8 ft. 4 in. in diameter and has 259 teeth. The pinion has twenty-six teeth, and the ratio of 26 to 259 gives the "hunting-tooth" feature which has been recognized as desirable in the design of toothed gearing. The speed of this gear at the pitch line is approximately 54 miles an hour. At full rated load of the generator the gear transmits 5,350 brake h.p., and on several occasions during overloads it has carried 6,000 brake h.p. without giving any indication that its ultimate safe output had been reached.

Portable Electric Grinders

The illustrations herewith represent a handy line of portable electric grinders just placed on the Canadian market by the Van Dorn & Dutton Company, through their agent, R. E. T. Pringle, Toronto. These grinders are a natural sequence to the economical and successful results obtained from the same company's electrically operated drill-

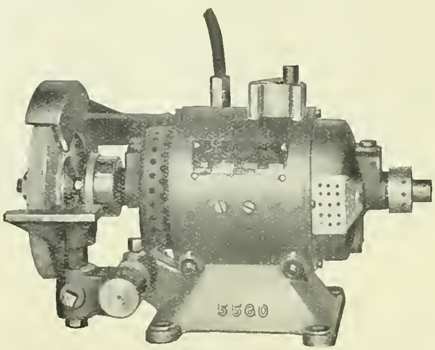


Fig. 1

ing and reaming machines and we understand they represent the same high standard of quality. The company states that these grinders represent the result of years of specializing in portable electrically operated tools and have been sub-

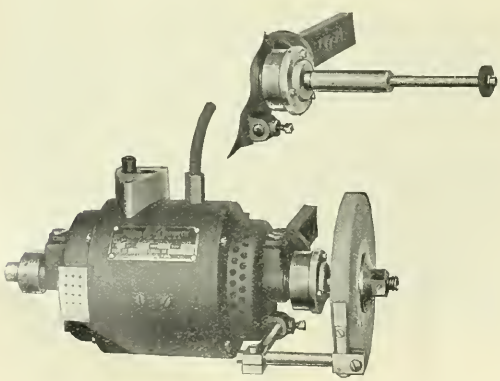


Fig. 2

jected to a most thorough test under varying and exacting conditions before being placed on the market.

The grinders are constructed by the most approved methods and represent the best mechanical and electrical practice. All parts are gauged and made accurate to micrometer dimensions which insures perfect interchangeability. The motor is form wound. The pole pieces are of Swedish steel and the motor shell of a special magnetic steel. A special process of insulation has been employed. Commutator is made from the best grades of drawn copper and soft silver amber mica. The brush holders are located on a fibre insulated base fastened to the head and are easy of access for

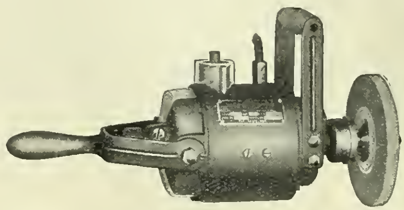


Fig. 3

inspection, cleaning or replacement. The wheel and bearings are of best grade phosphor bronze tapered. The thrust end bearings are finely adjustable. The journals are ground, producing a smooth wearing surface. Lubrication is by oil chambers cast integral with the motor housing. Cooling is by ventilation fan. Each machine is equipped with a cable of sufficient length and fuse plug for a connection to a socket. Any ordinary electric light socket may be used. The handles on all aerial types are adjustable and may be placed in any position to meet all conditions.

Fig. 1 represents a bench type suitable for grinding small tools or other general foundry, machine shop or boiler shop

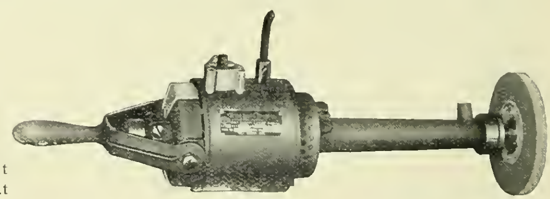


Fig. 4

grinding; also used for buffing and polishing. Fig. 2 represents a tool post grinder. It is calculated for internal and external grinding on laths, tool grinding or milling machine and surface grinder on planer and shaper; furnished with internal grinding attachment as shown. Fig. 3, representing an aerial type, with handles, is for general grinding, buffing and polishing. Fig. 4 is an aerial type with 12-in. extension used for general grinding where work is to be dressed inside. This type can also be used for buffing and polishing.

The Line Material Co.

Announcement is made that the Ajax Line Material Works, at South Milwaukee, Wis., will be known in future as the Line Material Company. A new president, Mr. F. L. Sivyer, has been elected, who is also president of the North Western Malleable Iron Company and the Sivyer Steel Casting Company. The Line Material Company is engaged in the manufacture of all kinds of line material, such as brackets, street hoods, tungsten fixtures, self-locking windlasses, hangers, mast arms, ornamental lighting posts, malleable iron posts, bolts, washers, etc. A new galvanizing plant has also just been installed.

The Twenty-fourth Annual Convention of the Canadian Association of Stationary Engineers will be held at Owen Sound Ontario, July 29th, 30th and 31st. There will be an exhibit in connection with the Exhibition.

The Fusette Fuse Plug

A long felt want is being handled by the Canadian General Electric Company, Limited, in the shape of a removable fuse plug, also called Fusette fuse plug. This fusette fuse plug is made up in two parts, the holder and the plug, or fusette, and only the latter requires renewing should the fuse blow. The holder is of the regular fuse plug design, with

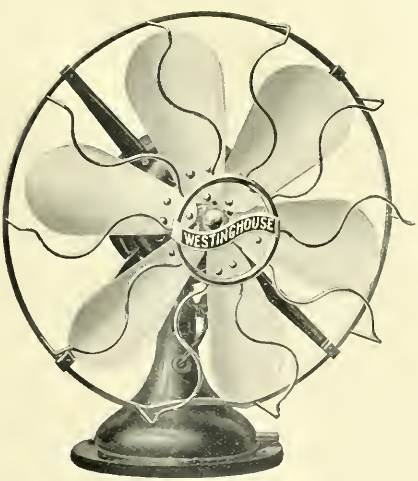
Fusette holder

Fusette

permanent metal cap and mica lining. It has a permanent inside brass sleeve with the necessary screw threads for fastening into a cutout. The fusette consists of a hollow piece of porcelain with a fuse mounted inside, and is so shaped as to fit into the brass sleeve of the holder. Fusettes are made in sizes of from 3 to 30 amperes. The holder and fusette make up the complete fuse plug. This little device will, we believe, prove a great convenience and money saver. The accompanying illustration explains the workings of the device.

6-blade, 16 inch Fan

The drawn steel fan, introduced last year by the Westinghouse Electric & Manufacturing Company, and which proved so popular, has been continued this year. The quiet running six-blade type of fan has been extended to include the 16 in. size, see illustration herewith, and also the oscillating type of fan. There has also been added an induction motor type of 8 in. fan. The six-blade fan, because of its slow speed is extremely quiet in operation and for this reason is particularly adapted for places where quietness is essential, such as libraries, reading rooms, hospitals, etc. The drawn steel frame of the desk and bracket and oscillating

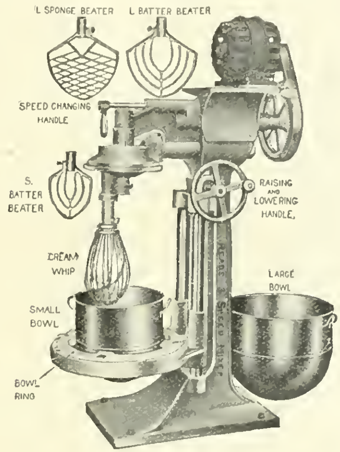


fans furnish a smooth surface, and is extremely pleasing with any finish. These fans can be mounted either on a horizontal surface or on the wall, the change being made without the use of any tools, and can be tilted or rotated in any position desired.

Motor Driven Mixer and Beater

The use of machines driven by small individual electric motors has proved a great source of economy in bakeries, confectionery plants, hotels, and restaurants. These machines do their work much more rapidly than it can be done by hand, and produce better and more uniform results at an insignificant expense of current. Hence the cost of labor is greatly reduced; the work can be put through with less delays, and working conditions in the kitchen or bakery are greatly improved by reducing the number of people employed in it and lessening the amount of material standing around and spilled.

Motor-driven machines of all kinds can be obtained; egg and cake beaters, dough mixers, dish washers, knife grinders, silverware polishers, vegetable parers, fruit pit-



ters, etc. The beater and mixer illustrated herewith is a typical example of these time and labor saving devices, and gives an excellent idea of what can be accomplished by them. This machine is applicable to all classes of plain and fancy cake, biscuit, and egg work, fruit and other pie fillers, jams, jellies, sauces, dressings and other preparations that require mixing and mashing.

The beating bowl rests on a stand which can be raised to the beater by turning a handle. When one operation is completed, the bowl is lowered and another substituted. A variety of styles and sizes of paddles, such as beaters for sponge, batter, eggs, cream, fruit, pumpkin, cheese cakes, and potatoes can be supplied for the machine; and, since one can be quickly replaced by another, the operation of the machine can be made practically continuous regardless of the kind of work to be done.

These machines are made by the Read Machinery Company, York, Pa., and Westinghouse motors are used to drive them. The motor has three speeds, any one of which can be obtained by turning a handle without stopping the machine. The capacities of the bowls which are supplied with the machine are 30 and 80 quarts. Where the mixture to be beaten must be kept hot or ice cold, a water bath is supplied.

Benjamin Products—The Benjamin Electric Manufacturing Company of Canada, Limited, are distributing their new catalogue C 21, which includes many new products and is a complete reference book for wiring devices, etc.

Current News and Notes

Aylmer, Que.

The town contemplates installing a complete electric lighting system at an estimated cost of $30,000.

Berlin, Ont.

It is now said that the Berlin & Northern Railway Company will not likely extend to Wellesley on account of difficulties in connection with an entrance to Stratford.

The Hydro-electric Power Commission of Ontario has placed the cost of street lighting for the current year at $16,000. This is a reduction from last year's figure although more lights will be in use.

The Berlin & Northern Railway Company, following a request to extend their line from Bridgeport to West Montrose and Conestogo, have requested assistance, including bond guarantee and bonus of $18,000 per mile. Mr. W. H. Breithaupt is president of this road and is carrying on the negotiations.

It is expected that the power load in this city will amount to 1,300 h.p. during the present year. The Light Commissioners are taking the matter of additional sub-station equipment up with the Hydro-electric Power Commission.

Brantford, Ont.

It is said that residents of a number of districts suburban to this city have petitioned for the installation of hydro-electric power and light.

Barrie, Ont.

Anticipating the advent of hydro-electric power from the Severn river, it is proposed to do away with the arc lighting system along the principal streets and substitute some 500 tungsten incandescents. These would probably be suspended from arms attached to poles already on the streets.

Calgary, Alta.

Net earnings of the Calgary Power Company for the year ending December 31st, 1912, amounted to $151,707. The estimated net earnings for 1913 is $270,000. The directors of the company are,—president, R. B. Bennett, K.C., M.P.; vice-president, H. S. Holt; E. R. Wood, Sir W. M. Aitken, R. T. D. Aitken, A. E. Cross, W. H. Hogg, F. P. Jones, H. A. Lovett.

During the past month the new 1,000 kw. railway generator in Calgary has been tested out on over-loads of 25 to 50 per cent. and is reported to be giving excellent satisfaction. A new 500 kw. Dick-Kerr railway motor-generator has also been put in service at the Ogden sub-station. The 1,000 kw. unit is of the Swedish General Electric Company, auto-synchronous type.

Cannington, Ont.

On April 15th, a by-law will be voted on to raise $12,000 by debentures for a hydro-electric distribution plant.

Edmonton, Alta.

The Northern Electric and Manufacturing Company has received a contract for 257,500 feet of steel wire for the municipal telephone department.

The council approved the plans to lay 10 miles more of railway. (1) From Highlands to Beverly Heights; (2) Up First street to Alberta avenue; (3) From Whyte avenue to 19th avenue south along 7th street east and along 19th to 10th or 12th street then up either of these streets. The property owners by which this railway passes are bearing the expense.

The city council have approved the principle of extensions to a number of suburban properties outside the city limits, the lines to be built by the property holders interested and their cost of operation guaranteed for a limited time, probably two years.

It is reported to be the intention of the Grand Trunk Pacific railway system to install telephone lines from Edmonton through to the Pacific coast, both for the operation of trains and the handling of commercial messages.

Ft. William, Ont.

It is reported that the Canadian Car & Foundry Company will install producer gas electric units to a total capacity of 3600 kw.

It is announced that the first work of the construction department will be to build the Island No. 2 extension to the street railway system. This is claimed to be most important in view of several new industries likely to locate there.

Goderich, Ont.

The Ontario West Shore railway on which considerable money has been expended by Mr. Jno. W. Moyes and his associates, may fall into the hands of the municipalities along the line. The latter have guaranteed the bonds of the company to the extent of $400,000.

Hamilton, Ont.

Contracts have been awarded for an electric pumping station to Geo. E. Mills, 614 King street east.

The Cataract Light & Power Company has announced a reduction of 25 per cent. in its commercial lighting rates.

Hanover, Ont.

The Hanover Electric Light & Power Company, Hanover, Ontario, expect to install meters shortly. In the past they have operated on the flat rate.

Halifax, N.S.

At a recent hearing before the railway and municipal committee of the legislature, Mr. E. A. Robert, president of the Halifax electric tramway system, made a strong argument against the proposed action of the city to expropriate the property of this company. Mr. Robert pointed out that an agreement between the city and the corporation should be as binding as between two individuals. He is also reported to have stated further, that the agitation for municipal ownership of this line rested primarily with Senator Dennis, who, with Mr. Lorne McGibbon, of Montreal, was anxious to secure control of the railway that they may urge extensions to exploit real estate properties recently purchased by them in the outskirts of Halifax.

Islington, Ont.

The franchise of the Toronto and York Radial Railway Company for the operation of their cars on the Lake Shore Road expired in January, 1912. As no new agreement has been made, and as the township did not show any inclination to take over the system, the Radial Company are now said to claim a perpetual franchise.

Kenogami, P.Q.

The second paper unit of Price Brothers & Company's new mill at Kenogami has started operation, thus bringing

the capacity of the plant up to 100 tons per day. It is expected that the third unit of 50 tons daily capacity will be in operation within six weeks.

Kenora, Ont.

Motor driven pumps in connection with the water supply department having a total capacity of 3,000 gals. per minute against a pressure of 70 lbs. will be installed here at an early date. The pumps will operate ordinarily in multiple, but in cases of fire will work in series giving 1,500 gallons per minute against a pressure of 140 lbs.

Kamloops, B.C.

Contract has been awarded for the construction of the power station building to Johnson & Company.

London, Ont.

Two new 500 h.p. steam turbine engines, generators and electrical equipment may be required shortly by the London Electric Company.

Manager Warburton, of the London & Lake Erie Transportation Company, is reported to have stated that he finds hydro-electric power more expensive than the old steam system. It is said that reductions in rate looked for by the railway company have not yet been forthcoming.

Work on the construction of the north end street railway lines is being carried on vigorously.

Merlin, Ont.

Estimates are to be secured for installing a new electric power plant for the town.

Medicine Hat, Alta.

It is said the contract for the building of a street railway in Medicine Hat has been signed by Sir Max Aitken representing the company, and that work will be commenced as soon as this agreement can be ratified by the ratepayers.

Moose Jaw, Sask.

The corporation of the city of Moose Jaw have just placed an order with the Siemens Company of Canada for a 1500 kw. turbo-generator. This machine will be 3600 r.p.m., 3-phase, 60-cycle type, direct-connected to a Willans & Robinson steam turbine.

Macleod, Alta.

The Electric Light Department report a surplus for the year 1912 of approximately $4,500.

Montreal, Que.

The plans and specifications for the underground conduit system to St. Catherine street, Montreal, are now ready for contractors to tender on the work. The plans and specifications have been prepared by the Electrical Service Commission, which is also preparing plans for other streets. The tenders will have to be in on April 25th, and must be for the whole of the work.

There is evidence that the City of Montreal and the Tramways Company are getting closer together with a view to improving and extending the service. The president of the company announces that a plan will be submitted with this end in view, and the council also desire time to study the reports of three experts who have examined the situation. It is proposed to eliminate some of the stops, Mr. J. E. Hutcheson, the manager of the company, favouring a stop every 600 to 700 feet.

The directors of the Montreal Tramways Company have declared an interim dividend of 5 per cent. on the capital stock, and announce that a new issue of $1,000,000 at par will be made. This is the first dividend under the scheme of reorganization adopted in 1911.

It is officially announced that the following programme of telegraph construction will be carried out during the year by the Grand Trunk Pacific Company—a line will be erected from Harte, Man., to Brandon, while the Regina and International Boundary line, the Regina-Moose Jaw branch line, the Young-Prince Albert branch line, will be completed, as also a Battleford section through the Cut Knife district, an extension from Biggar, and the Tofield-Calgary line. The main line between Tete Jaune Cache and the Shuswap River, B.C., is being built and construction work carried on at New Hazelton, and the end of steel.

The National Hydro-Electric Power Company, who propose developing the Carillon Falls, have just put in operation the first unit of 250 h.p. Work is proceeding on the second unit of similar size, and these will be ultimately used in the construction of the large plant which it is proposed to erect. The plans for the latter are well under way. The small quantity of power now being generated will in the meantime be sold to local buyers.

The Montreal Jovian Club has been formed and the upper floor of Copper's Restaurant has been engaged for a permanent meeting place. The club will be opened this month, and it is also proposed to hold weekly luncheons. Another rejuvenation will be held during April.

The Canadian Car & Foundry Company, Montreal, propose to install in their new plant which is now being constructed in Fort William, Ont., gas-producer electrical equipment to the extent of 2500 kw. The company have purchased the gas-producer equipment from the R. D. Wood Company, Philadelphia; the gas engine from the Mesta Machine Company, Pittsburg, and the generator, alternating current, from the Allis-Chalmers-Bullock Company.

Mr. D. E. Morkill, of the Grand Trunk Railway Signal Department read a paper on "Train Despatching by Electrical Methods" for the members of the Montreal Electrical Society, on April 4th. Mr. Morkill described the different systems used by the railway companies, referring in particular to the staff system. Mr. P. T. Davies presided.

Nelson, B.C.

The annual report covering the operations of the street railway system of the year 1912 show that there is still a small deficit to be overcome. Operations for the first two months of the present year indicate that profits will be considerably greater in 1913.

Owen Sound, Ont.

The Hydro-electric Power Commission of Ontario offered this town 1500 h.p. on a $29 rate. As the feeling is against contracting for such a large amount, a quotation on 800 h.p. is now asked.

Ottawa, Ont.

About a dozen underground new mains are to be laid by the Ottawa Municipal electric lighting plant for the purpose of supplying new customers.

The town of Eastview contemplate a new street lighting system. C. Gladu, McArthur road, is mayor.

To relieve the street car congestion on Sparks street the Ottawa Electric Railway Company are going to lay a single track on Queen street as soon as the weather permits. The extension of the double track Bank street line from the exhibition grounds to Billings Bridge in Ottawa south, a distance of about one mile, will be under way early next month. As soon as the extension is completed 20 new double truck cars are to be put into service.

An agitation is being started by Controller Hinchey for the establishing of a municipal gas plant in Ottawa. Infor-

mation as to the feasibility and wisdom of such an undertaking is now under serious consideration.

Ornamental standards, cast iron, with 5-cluster lights are contemplated in Somerset street. Length of proposed system about 2 miles.

Contracts have been awarded as follows,—tape, solder, motor, incandescent lamps to Garrioch, Godard & Co.; copper wire, split knobs, carbons, arc lamp globes, transformers to Canada General Electric Company; insulators, top-pins, Northern Electric & Manufacturing Company; meters, Ferranti Electrical Company.

Evidence will be taken before the Ontario Railway and Municipal Board on the value of Chats Falls, on April 29th. This power is being expropriated for development purposes by the Hydro-electric Power Commission of Ontario.

Mr. V. Gandil, a director of the Universal Radio Syndicate, Limited, London, Eng., has been on a visit to Ottawa with a view to getting the Federal authorities to approve of the establishment of a direct wireless system between Great Britain and Canada.

Prince Albert, Sask.

The telephone department has purchased the material for the new telephone building here and the work of erection will begin immediately according to a statement of the Provincial Minister of Public Works.

Port Arthur, Ont.

Tenders will be received by Commissioner J. J. Hackney, until April 21st for 600 4-pin cross arms, 600 6-pin cross arms, 400 10-pin cross arms, 6,000 top pins (locust or birch), 2,400 cross arm braces(galvanized), 6,000 pole steps, 5/8 by 10 in. (galvanized), 6,000 glass insulators, D.G.D.P., 400 strain insulators, 5,000 No. 4 porcelain knobs. Tenders have also been called for 12,000 ft. of 400-pair cable, 25-25 pairs cantop cable terminals with cable, 30-15 pairs cantops with cable, 25-10 pairs cantops with cable, 500 protectors, 10,000 paper sleeves, 800 lbs. lead sleeving, 8,700 ft. of 4 multiple clay conduit, 600 lbs. wiping solder (easy wiping).

Also received by commissioner until April 21st for 100,000 ft. of style "B" wire No. 18, 20,000 ft. of style "C" wire No. 20, 20,000 ft. of pot head wire No. 22, 4,000 lbs. messenger wire, 1,000 lbs. guy wire. 6 tons No. 2/0 stranded D. B. W. P. wire, 6 tons No. 1/0 stranded D. B. W. P. wire, 5 tons No. 6 solid D. B. W. P. wire, 2 tons No. 10 solid D. B. W. P. wire, 1 ton No. 12 solid D. B. W. P. wire.

Regina, Sask.

Plans are being prepared by the Provincial Government Department of Railways, Telegraphs and Telephones for about 1½ miles of telephone conduit and 1½ miles of trenching 6 ft. deep.

Ridgeway, Ont.

Fire destroyed the exchange of the Bell Telephone Company here recently.

Stayner, Ont.

The Stayner Electric Light Company have sold their plant to the town, and hydro-electric power will be purchased from the Hydro-electric Power Commission of Ontario. This town is on the line fed from the Severn river.

St. John, N.B.

Following objections from numerous quarters the matter of the erection of a dam on the St. John river by the St. John Hydro-electric Power Company will be considered by the International St. John River Commission. It is understood the plans of the company call for a dam across the St John river at a point about 40 miles above Fredericton, the dam to be 25 ft. high. Lumber interests and fishing interests have both opposed the proposition and now it is stated that the work would be contrary to a treaty existing between the United States and Great Britain which provides that the navigation of the St. John river shall be clear and unobstructed to the citizens of both countries from its source to its mouth.

Swift Current, Sask.

The contemplated addition to the power house and electric light plant is estimated to cost $100,000.

Sherbrooke, P.Q.

A judgment of interest was recently rendered by Mr. Justice Hutchinson in connection with the rights of a street car on the streets of a city. The action followed a rear collision with a milk wagon, the owner of the wagon making claim for damages. It was contended by the railway company that the gong was sounded and ample time given the driver to get out of the way, but Justice Hutchinson, in allowing the milkman's claim, states that a railway company has no right to run into and damage a citizen's vehicle. It is suggested however, that a driver, in blocking the passage of cars, may render himself liable to a fine and possibly to a claim for damages.

St. Thomas, Ont.

The St. Thomas city council has raised the price of fares on the municipal street railway system to 6 for 25c and 8 limited for 25c. In the past the tickets have been 8 and 10 for 25c for the same class.

Saskatoon, Sask.

The offer of a syndicate of several property owners to build an electric line between Sunderland and this city has been accepted. The syndicate agrees to construct the road according to the specifications of Electrical Superintendent Hanson, and then hand it over to the city free of cost. The city on their part agree to operate the railway, giving an hourly service between 6 a.m. and 12 p.m.

The p.a.y.e. system has been inaugurated on the municipal street car system here.

Toronto, Ont.

A contract has been awarded by the Hydro-electric Power Commission of Ontario to John Hayman & Sons, London, Ont., for the construction of a sub-station to be situated between Brantford and Paris. The station is a one-storey, 60 ft. x 80 ft., cement foundation, brick and structural steel construction, concrete and maple floors, felt and gravel roof, fireproof doors, wire glass windows, etc. The transformer equipment in this sub-station will be supplied by the Canadian Westinghouse Company of Hamilton.

By a vote of three to two, the Board of Control has sent on to council, a motion that it is inadvisable to lay civic car lines on the local improvement plan.

The New York State Public Service Commission has handed down an elaborate decision in the complaint against the electric rates charged by the private companies in Buffalo, N.Y., as recently investigated before expert evidence by that Commission. A reduction is ordered of 25 per cent. in the rates of both the private companies operating.

The Board of Control and the York Radial Railway Company are not yet able to agree on terms in connection with the proposal to double track upper Yonge street and allow a joint use of the tracks.

The four large electric pumps situated in the main pumping station at the foot of John street are now completed. These have a capacity of approximately 50,000,000 gallons

and are sufficient to meet the requirements of the city under ordinary circumstances. The steam plant, however, will be kept as an auxiliary or for emergency.

By a recent act of the legislature, the city of Toronto will be allowed to operate cars on the municipal lines on Sunday.

The city has been notified that the application of the Toronto and Niagara Power Company for permission to construct its proposed transmission line along the Lake Shore road has been approved. It is understood, however, that the proviso is included that all wires following this course, owned by whatsoever company, must be strung on one single pole line.

The Bell Telephone Company has secured a permit for the erection of a $34,000 two-storey brick and steel telephone exchange near the corner of Bathurst street and Helena avenue.

Contracts have recently been awarded by the Ontario Hydro-electric Power Commission for extensions to their high tension transmission line from St. Thomas west to Windsor and a duplication of their present single-circuit line from Dundas to St. Thomas. The Canadian Westinghouse will supply the transformer and switching equipment required, which will probably be about 5,000 h.p. capacity in both Chatham and Windsor. In connection with the second line from Dundas to St. Thomas extensions will be made to the Dundas, St. Thomas and London sub-stations. The Canadian Westinghouse will also supply the switching equipment necessary for these extensions. Other successful tenderers were the Canadian Bridge Company, Walkerville, for steel towers and footings; the Canadian Porcelain Company for insulators; the Galt Malleable Iron Company for malleable clamps, and W. H. Dunne, Toronto, for pressed steel clamps.

Commissioner Harris has been given power to purchase car barn sites in connection with the operation of the St. Clair avenue municipal line. It is reported that tenders will probably be called for the necessary rolling stock and other equipments in the very near future.

The Toronto Electric Light Company have placed an order for the installation of a 7500 kw. steam turbo-generator. The installation will be completed about July 1st.

Owner, City Council. Tenders have been called for trolley wire, cable, suspensions, hangers, pull overs, sleeves, ears, frogs, bolts, bonds, etc., for St. Clair avenue.

Truro, N.S.

The Board of Commissioners of Public Utilities have taken evidence on the questions at issue between the town of Truro and the Chambers Electric Light & Power Company regarding the new schedule of rates proposed by the company which were to go into effect on April 1st.

Vernon, B.C.

Tenders were received up to April 11 by D. G. Tate, city clerk, for a ten ton hand-operated travelling crane. Mather, Yuill & Company are consulting engineers.

Vancouver, B.C.

The British Columbia Electric Railway Company has announced that reductions would be made in the charges for light in wards 7 and 8, beginning April 1st. It is also announced that the question of general reduction in rates throughout the city will be taken up by the company.

Weston, Ont.

Judge Morgan has handed down a decision in the matter of the legality of the election of Dr. Irwin and Mr. J. Cruikshank, as members of the water, fire and light committee. The election of these two members is voided on the ground that they are high school trustees, and, as such, are not eligible as members of the committee.

Windsor, Ont.

It is reported that an electric railway line will be built and operated on the Canadian side of the Detroit River between Amherstburg and Kingsville, this line to be operated by power from the Edison Company's system, Detroit, and owned by United States capital.

Winnipeg, Man.

Contract has been awarded to The Standard Underground Cable Company, Hamilton, Ont., for 30,000 ft. rubber covered cable for Light and Power Department.

The installation of the ornamental lighting system on North Main street will be proceeded with with as little delay as possible. The cost is estimated at $80,000.

Contract has been awarded to E. F. Phillips Electrical Works, Limited, for 42,500 lbs. No. 0 standard copper cable of medium hard drawn bare copper wire. Owner, Board of Control. Secretary, M. Peterson.

Tenders have been called by the Manitoba Government Telephone Department for the construction of about 1,000 miles of rural telephone line. Government supplies materials.

Owner, Board of Control. Council have passed a resolution for ornamental street lights on Colony street from Ellice avenue to Assiniboine River at an estimated cost of $7,500.

Welland, Ont.

Plans are in progress for an extension to the Welland Street Railway system.

Wiarton, Ont.

A by-law was passed on April 2nd, authorizing the issue of $6,500 debentures, part of which is being used to install new electric pumps.

Toronto Hydro-Electric System

Second Annual Report of Toronto Electric Commissioners

Commissioners' Report

To His Worship the Mayor and the Members of the Council of the Corporation of the City of Toronto:

Toronto.

Gentlemen,—

Your Commissioners beg to submit their Second Annual Report, accompanied by the Revenue Account and the Balance Sheet of the Toronto Hydro-Electric System for the year ended 31st December, 1912.

The accounts have been audited by John Mackay and Company, Chartered Accountants, Toronto, under the joint appointment of the Provincial Hydro-electric Commission and your Commissioners. Their certificate is appended to the accounts in question.

FINANCIAL POSITION AS AT 31ST DECEMBER, 1912:

The operations for the year 1912 have yielded satisfactory results. From the Revenue Account annexed hereto it will be observed that:

The gross income amounted to the sum of	$726,763.55
The cost of electric current and the expenses of operation and management, including repairs and maintenance, absorbed the sum of	500,564.26
Leaving a balance of net income of	$226,199.29
The interest chargeable against current operations for the year, sinking fund instalments for the year, and provision for the depreciation reserve fund, absorbed the sum of...	212,643.88
Leaving a balance of net surplus earnings for the year 1912, after meeting all charges applicable thereto, to carry forward to 1913 of	$ 13,555.41

It is to be especially noted that the expenses and charges generally described above, and which have been defrayed out of the year's income, include the total cost of getting business and promoting new business. The expenditure for advertising and for canvassers, etc., in prosecuting this important work amounted to over $53,000 for the year. In view of the volume of continuing business which has been procured as a result thereof, it would have been quite in accordance with commercial practice to carry forward as a charge against future profits a part of this expenditure. Your Commissioners, however, preferred to follow the conservative course of charging the total expenditure of the year against the income of the year.

The sinking fund accruing to the almost purely construction period ended 31st December, 1911, and which is carried as from that date as a charge against future profits, amounts as per the Balance Sheet to $50,985.49. The final result, therefore, of the operations for 1912 has been that of discharging in full the deficiency that accumulated during the earlier part of the year, when the revenue was smaller, and of accumulating a surplus of $13,555.41 to apply on the sinking fund obligations of the construction period, thus leaving only $37,430.08 of that obligation to carry forward against future earnings.

The net earnings are continuing to improve during the current year in a satisfactory ratio, and your Commissioners therefore feel warranted in stating that the surplus for the present year 1913 should, in their opinion, discharge the balance of sinking fund liability arising from the construction period, and leave a margin that will justify a reduction of rates in 1914.

The net result of the 1912 operations is more favorable than was anticipated from the interim approximate accounts prepared from time to time during the year. A very gratifying increase of business in the latter part of the year, together with the pleasing reduction of rates made by the Provincial Commission, a reduction in the rate of interest from that on which the interim accounts were based, and other matters, contributed to the ultimate satisfactory result.

It is perhaps worth noting that had the enterprise been conducted under share capital as an ordinary commercial corporation, instead of under debenture capital subject to repayment, the provision that has been made out of income for interest and sinking fund instalments, together with the surplus carried forward to next year (amounting to nearly $158,000) would have been available for dividend, and would have permitted the payment of a dividend at the rate of over 5 per cent. for the whole year on the average capital of $3,000,000 employed during the year. And this result has been effected on a scale of rates very much lower than the City and the Citizens had previously enjoyed, and on a volume of business that is still in the infancy stage of development.

The estimated cost of the completed plant as finally decided upon by your Commissioners was $4,500,000. Of this amount $3,734,911.33 has been expended to the end of 1912, leaving an unexpended balance against the completion of construction operations of $765,088.67. This sum will be sufficient to complete the work included in the $4,500,000 estimate.

The condition of the money market during the past year had the effect of leading your Commissioners to moderate the rate of construction progress, with the object of reducing their financial calls upon the Corporation.

CIVIC SERVICES:

Very satisfactory arrangements have been entered into with the Waterworks Department, which should prove of interest and value to the citizens in connection with the most important question of water supply. These arrangements cover the maintenance by the Waterworks Department of a complete steam pumping plant to be used by it during "Electric-Peak" hours, while, during "Off-Peak" hours electric power will be used. This insures to the Waterworks Department two sources of power supply, thereby protecting the citizens against the dangerous risks attendant upon a single source of supply, while at the same time it gives the Commission a substantial customer for "Off-Peak" periods. The

(Continued on Page 62)

Revenue Account of the City of Toronto Hydro-Electric System for Year Ended 31st December, 1912

Section 1—Showing Net Earnings from Total Operations for year

CHARGES

	Amount	Total
To cost of electric current	$ 194,328.19	
To expenses of operation and management, including repairs and maintenance; provision for special depreciation of leasehold buildings and improvements ($3,041); provision for actual and contingent losses on accounts receivable, and for all accrued charges as at 31st December, 1912......	306,236.07	
		$ 500,564.26
To balance Profit carried forward to Section II.		226,199.29
		$ 726,763.55

INCOME

	Amount	Total
By Income From—		
Commercial lighting	$ 197,739.21	
Commercial power	94,400.05	
Municipal buildings	3,815.53	
Municipal power	106,619.38	
Municipal street lighting	275,666.23	
Exhibition light and power	22,032.35	
Other municipalities	2,399.77	
Sundry other sources	24,091.03	
		$ 726,763.55
		$ 726,763.55

Section 2—Showing Disposition of Net Earnings

	Amount	Total
To interest (one-half charged against construction accounts till 30th September..$	86,443.19	
To provision for depreciation	68,568.20	
To sinking fund instalments for year, including amount accrued at 31st December, 1912, and interest on past due instalments	57,632.49	
		212,643.88
To balance, representing surplus profits carried forward to 1913		13,555.41
		$ 226,199.29

	Total
By profit brought down from Section II..	$ 226,199.29
	$ 226,199.29

Balance Sheet as at 31st December, 1912, of the City of Toronto Hydro-Electric System

ASSETS

FIXED

	Amount	Total
To Capital Expenditure on—		
Lands, buildings, transmission system, sub-station equipment and feeder system, distribution system, municipal street lighting system, line transformers, meters, equipment and devices, general office stores department, utility department and miscellaneous equipment and Exhibition construction and equipment	$3,672,800.22	
Leasehold premises and improvements..	62,111.11	
		$3,734,911.33

LIQUID

	Amount	Total
To stores on hand	$ 254,003.55	
To accounts receivable (cash value)	314,733.13	
To cash on hand and in bank	4,904.13	
To prepaid charges	1,074.40	
To City Treasurer's suspense account ...	8,546.35	
		$ 583,261.56
To sinking fund suspense account—for amount of sinking fund instalments accrued during construction period and carried forward as a charge upon future profits	$ 50,985.49	
		$ 50,985.49
		$4,369,158.38

LIABILITIES

ON CURRENT ACCOUNT

	Amount	Total
By Sundry Accounts Payable		
Including charges accrued to date .....$	433,287.30	
By Corporation of the City of Toronto—		
Interest to date, including $8,546.35, under adjustment	94,989.54	
		$ 528,276.84
By Sinking Fund—		
Instalments due and accrued to date to extinguish capital debt to Corporation of the City of Toronto by 1st July, 1948, the date on which the city debentures fall due	106,610.51	
Interest to date on past due instalments of sinking fund	2,007.47	
		$ 108,617.98
		$ 636,891.82

ON CAPITAL ACCOUNT

	Amount	Total
By Corporation of the City of Toronto—		
Advances under by-law No. 5,036, including interest capitalized thereunder ...	$2,539,005.60	
Advances under By-law No. 5,918, including interest capitalized thereunder ...	1,108,093.35	
		$3,647,098.95

ON SURPLUS ACCOUNT

	Amount	Total
By Depreciation Reserve Fund—		
In respect of general system, after providing out of income for repairs and maintenance of buildings, plant, and equipment... ... ...$	68,586.20	
In respect of leasehold buildings and improvements	3,041.00	
Total ... ... $	71,609.20	
By surplus Earnings for Year		
After providing for expenses of operation, management and maintenance, for actual and contingent losses, and for interest, depreciation, and sinking funds ...	13,555.41	
		85,164.61
		$4,369,158.38

estimated cost to the Waterworks Department of maintaining under this combination the two sources of supply does not exceed the cost of maintaining the steam plant alone under the old arrangements. The Civic Street Car System is also being successfully operated with electric power furnished by the Commission.

GROWTH OF CITY AND ITS OBLIGATIONS:

Attention is drawn to the fact that the growth of the city will necessitate from time to time capital extensions to the Hydro-electric System. The mileage of the streets of the city was increased during 1912 from about 408 to 508 miles; the population is increasing; industrial activity shows no sign of abatement; and the services to the public which the Hydro-electric System was established to render must be adapted to the enlarging conditions and to the increasing demand that will arise therefrom. The undertaking as confirmed by the public at the time of the passage of the last By-law provided for 13,000 services, while at the present time nearly 17,000 services are established. While, however, these conditions will compel, from time to time, enlargements of the system, it is to be noted that the system as it stands today is capable of bearing the load of greatly increased demands from the public at large. Wherever Hydro lights are to be found in the streets, there is room and there are facilities for extending the service to the public.

GENERAL CONDITIONS:

That the work accomplished to date has been productive is sufficiently evidenced by the annexed accounts. It has not, however, been free from difficulties. On the contrary, your Commissioners have had to deal with serious and exacting administrative, construction, and technical problems which have laid upon them an arduous burden of work. Nor is this work by any means finished. The potentialities of the system are very great. The development of a perfect, frictionless, and economical organization adapted to the increasing needs of the public and to the enlarging area of the city will always impose a burden of responsibility and concentrated work upon those to whom it is entrusted.

The final result of this venture into a new and wide field by Commission government under municipal auspices will also exert a great influence on the future limits of municipal enterprise. This additional responsibility is deeply felt. Your Commissioners have absolute confidence in the outcome.

For the confidence and the sympathetic support extended by the Prime Minister of the Province, Sir James Whitney, by the Provincial Hydro-electric Commission, by the Board of Trade and the Manufacturers' Association, by the press as a whole, and for the active support rendered by the municipal corporation of the City of Toronto, and by the citizens at large during the past year, they are deeply grateful. Such support and confidence can but stimulate them to further exertion in the work to which the city is now finally committed.

Respectfully submitted on behalf of the Commissioners.

P. W. ELLIS, Chairman. H. C. HOCKEN, Mayor.

Toronto, Canada, 4th April, 1913.

GROWTH DURING 1912:

The growth in the services rendered the public during the year 1912 is striking, as the following table shows:

Particulars	At Jan 1. 1912	At Dec. 31 1912	Increase
Meters in use	3,901	13,858	9,957—255%
Lamps in use	87,270	300,024	212,754—244%
Street lanterns in use ...	18,800	33,824	15,024— 80%
Connected load, h.p.	10,811	54,655	43,844—405%
	Jan.	Dec.	
Peak load, h.p.	5,934	17,198	11,264—190%

AUDITOR'S REPORT

Toronto General Trusts Building,
85 Bay Street, Toronto, 3rd April, 1913.

The Toronto Electric Commissioners,
Toronto.

Gentlemen,—

We beg to annex hereto the Revenue Account for the year ended, and the Balance Sheet as at 31st December, 1912, of the Toronto Hydro-electric System. We have audited the books and accounts of the System from the 1st June, 1911—the date upon which you assumed control of the administration—to the 31st December, 1912. The expenditure upon the System from its inception until the 31st May, 1911, (during which time it was administered by the municipal corporation of the City of Toronto), amounting to approximately $1,400,000, has not been audited by us, and we therefore assume no responsibility in connection therewith. Subject to this reservation, we certify as follows:—

(1) No expenditure has been charged to Capital Account except such as is properly attributable thereto. That portion of the interest which constitutes an integral part of the cost of construction has been charged there against. By-law No. 5,918 of the City of Toronto authorizes the issue of $2,200,000 of debentures for the express purpose of providing, inter alia, for the said interest charge.

(2) The Income Account for the year has been charged not only with the usual expenses of operation and management, but with the whole of the cost of getting new business, no part of which has been carried forward; and with provision for actual and contingent losses, for special and general depreciation in addition to the cost of repairs and maintenance, for interest chargeable against current operations, and for the full requirements of the sinking fund necessary to extinguish the debt incurred.

(3) The inventories of stores on hand at 31st December, 1912, while checked by us as to calculations—have been accepted in the usual way as to quantities and prices on the certificates of responsible officers. The inventory of stores on hand at 31st December, 1911, amounted to approximately $113,000 less than the stores which, according to the books, should have been on hand at that date. The missing stores in the interval have been traced and satisfactorily accounted for, except to the extent of $6,562.06. In our opinion, after full inquiry, there is little doubt but that, subject to the usual wastage, which itself is a charge upon the operations causing it, the stores represented by this deficiency were consumed upon construction operations and through oversights in the stores department not charged thereagainst. The amount has therefore now been charged against Capital Expenditure Account.

(4) Our requirements as Auditors have been complied with, and in our opinion the annexed Revenue Account and Balance Sheet are properly drawn up so as to exhibit a true and correct view of the state of the affairs of the enterprise.

We may add that the interim approximate accounts prepared from time to time during the year subject to adjustment in some important matters, showed a less favorable result than is disclosed by the annexed accounts, for the reason that in the interest of safety they were loaded for contingencies to a greater extent than has proved necessary.

Respectfully submitted,

JOHN MACKAY & CO., Auditors.
Chartered Accountants.

Electrical News

Generation, Transmission and Application of Electricity

PUBLISHED SEMI-MONTHLY BY

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ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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Vol. 22 Toronto, May 1, 1913 No. 9

Electric Vehicle Publicity

The Electric Vehicle Association of America was formed a little over a year ago for the purpose of placing the merits of electric vehicles before the interests most nearly concerned. These included central stations and manufacturers not only of electric vehicles themselves, but of any kind of product in which an electric vehicle could be used in transportation work. It is the intention of this association to bring to the attention of central stations the value of the business which comes from charging storage batteries used by electric vehicles. This business not only represents an extension to their trade, but what is often of much greater importance, it represents a customer that can be supplied at a time when the plant is running very low. Indeed most of the electric vehicle charging business is done during the night when practically every other consumer is off the line.

The Association has also endeavored to bring to the attention of the manufacturer or other organizations requiring transportation facilities, the advantages that storage battery vehicles possess over horse drawn, or even gasoline. It has been shown that more work can be done in less time, and at less expense, and the result has undoubtedly been that the situation with regard to the electric vehicle business is much more prosperous than it was twelve months ago.

As this organization may be considered a philanthropic one, it has been dependent for the defrayal of its operating expense on private subscriptions. The list of contributors include, principally, manufacturers of electric vehicles, who profit directly by the publicity given their product by the Association, and central stations who profit indirectly by the increased load resulting from the greater use of the storage battery. With the beginning of the second year of this association's operations it now becomes necessary to make an appeal for further contributions, and letters are being sent out to three classes—first, to those who contributed to last year's campaign fund; second, to manufacturers who did not contribute to last year's fund, and third, to central stations who did not contribute last year. In these letters it is pointed out what the value of the advertising carried on by this association has meant to the industries during the past year. It is stated that inquiries have been received from every state in the United States and from more than twenty-five outside countries. The letters further state that the scope of the campaign literature will now be extended, and whereas in the past this has been almost purely educational, the second year's campaign literature will make the matter more specific, and by giving facts, figures and data with respect to the electric vehicle will make a direct appeal to the purchaser. Two booklets will be issued during the present year, one entitled "The Story of the Electric Commercial Vehicle," the other "The Story of the Electric Pleasure Vehicle," which will each be published in attractive form.

Attention is especially drawn to the splendid results obtained by the past year's advertising, but it is pointed out that the foundation work only has been done. While the public are beginning to appreciate the value of the electric vehicle, it is absolutely necessary that the work of education must be continued without intermission, so that the foundation already laid may not become valueless. A strong plea, therefore, is made for sufficient funds to carry on this work during the present year.

The Electric Motor

In this issue we have made an attempt, in an article of some length, to cover, in a general way, the field of the use of electric motors. We make no claim to discovering applications of motors that were not fully recognized before, but we believe this is the first attempt that has been made to assemble, as it were, the various parts of the motor-driven industry, which, taken together, form the basis of 20th century progress. We are free to admit, however, that though we have devoted some seventeen pages to this subject, much has remained unsaid that would naturally have found space in such an article.

Still, the simple fact that seventeen pages is insufficient to do much more than touch the fringe of this subject, is indicative of the already widespread application of electric motors. The article, incomplete though it is, has gone far enough to prove to the most sceptical that there is no industry nor any phase of any industry that cannot be served efficiently and economically by electric drive.

Fire Prevention Device

The Fire Prevention Company of Canada, Limited, Montreal, propose to put on the market a device invented by Mr. L. T. Reichel, formerly chief electrical engineer for the New Zealand Government, and now in use in that country and in Great Britain. The device is the adaptation of an old principle, and it is claimed to be both fool proof and trouble proof and free from false alarms. Small thermopiles, containing dissimilar metals, are placed on the walls or ceilings, one to each one hundred square feet of space, and these are connected by means of wires with a sensitive galvanometer, which in turn is connected with a local and central alarm bell, and at the same time indicates the location of the fire. A sudden rise in temperature of four degrees acting upon the exposed ends of the thermopile, generates a sufficient current of electricity to at once automatically set

the alarm system in operation. In case of a wire or other part breaking, an automatic signal gives the alarm to the central office, and this signal is persistent until the trouble is put right. The chief feature of the system is the galvanometer, which is used in combination with the ordinary clock work mechanism usual in all fire alarm systems, but another quite important feature is that an alarm can be given by hand in the event of a fire being discovered before it has had time to be automatically recorded. Should a wire break on the street or elsewhere outside of the premises protected by the system, the trouble signal is given to the central station by means of the McCullough system of grounding the current.

The Canadian Fire Underwriters' Association have recognized the system and will allow an appreciable reduction in the rate where the apparatus is installed in commercial premises. Mr. James Bennett is the managing director of the company, who are also putting on to the market a number of other fire preventative appliances.

Cedars Rapids Contract

After doing a portion of the construction themselves, the Cedars Rapids Manufacturing and Power Company have let a contract for the remainder of the work to Messrs. Fraser, Brace & Company, of New York. The cost will be over $3,000,000 and is on a unit price basis. The work already done includes the crib work on the outer bank of the canal, and Messrs Fraser, Brace and Co. will complete the canal and build the power house. Operations were commenced immediately after the signing of the contract, which provides for an initial installation of 100,000 horse power. The hydraulic portion of the scheme is under the direction of Mr. Julian C. Smith, chief engineer of the Shawinigan Water & Power Company, and the installation of the electrical machinery will be under Mr. R. M. Wilson, chief engineer of the Montreal Light, Heat & Power Company. Mr. Charles E. Fraser is a native of Montreal, and a graduate of the Faculty of Applied Science at McGill. He was at one time engaged in journalistic work. His firm carried out a considerable portion of the work on the plant of the Canadian Light & Power Company, St. Timothee, P.Q.

Messrs. Stone & Webster, of Boston, have secured the contract for building the transmission line from Cedars to Messina, N.Y., a distance of about 50 miles, for the Aluminium Company, who have agreed to take a large amount of power from the Cedars company.

Canadian Allis-Chalmers, Limited

Announcement has been made by Mr. Frederic Nicholls, president and general manager of the Canadian General Electric Company, that negotiations are now concluded with the Allis-Chalmers Company of Milwaukee, and the Allis-Chalmers-Bullock Company, of Montreal, by which the Canadian General Electric Company acquires all the properties and assets of the Allis-Chalmers-Bullock Company in Canada. An agreement has also been made with the Milwaukee company, which gives the exclusive right to manufacture and sell in Canada the types of apparatus for which the Allis-Chalmers company have achieved a reputation, such as Corliss engines water wheels, sawmill machinery, flour mill machinery, mining machinery, cement machinery, gas engines, etc.

The business will be conducted under the name of the "Canadian Allis-Chalmers, Limited," a charter having been applied for. Mr. Milne, manager of the Allis-Chalmers-Bullock Company, will continue as manager of the new company. The Canadian General Electric Company, with its subsidiary companies, the Canada Foundry Company, and the Canadian Allis-Chalmers, are now in a position to build and equip completely any industrial enterprise, as they manufacture the structural steel required for the buildings; Corliss engines, steam turbines or water wheels for the motive power; boilers, pumps, electric cranes and everything else required for the equipment, and sawmill machinery, flour mill machinery, mining or cement machinery for operation.

It has been finally decided to hold the annual convention of the Canadian Electrical Association in Toronto, instead of in Fort William as announced some weeks ago. The date of the convention in Toronto will be June 25, 26 and 27.

Comparative Cost of Delivery by Electric, Gasoline and Horse Power

A paper was recently read before the Electric Vehicle Association of America by Prof. H. F. Thompson of the Massachusetts Institute of Technology on the above subject. Prof. Thompson gave some interesting cost figures comparing the operation of the three types of vehicles, horse-drawn, electric and gasoline, which showed an economy of motor vehicles over horse-drawn trucks. Following are the figures submitted:

	1000 lb. Electric	1000 lb. Gasoline	1 Horse Wagon (2-3 extra horse)
Average running speed, to and from delivery zone, m. p. h.	11	15	6.5
Average running speed in delivery zone	9	9	5
Hours per day for loading	2.0	2.0	2.0
Hours per day to and from delivery zone	1.45	1.1	2.5
Hours per day in delivery zone	5.55	5.9	4.5
Miles per day to and from delivery zone	16	16	16
Miles per day in delivery zone	21	23	13
Miles per day, total	37	39	29
Deliveries per day	128	138	78
Deliveries per mile of total day's travel	3.5	3.5	2.7
Days used per year	285	275	285
Miles per year	10,500	10,500	8,300
Deliveries per year	36,500	37,000	22,000
Expense per year—			
Tires or shoeing	$ 170.00	$ 190.00	$ 60.00
Repairs	300.00	550.00	125.00
Battery	250.00	......	......
Veterinary	......	......	10.00
Lubricants	15.00	50.00	......
Electricity, 3c. per kw. hr.	160.00	......	......
Gasoline at 16c. per gal.	......	215.00	......
Feed	......	......	320.00
Garage or stable	200.00	200.00	125.00
Driver or helper	1,000.00	1,080.00	1,000.00
Depreciation	165.00	305.00	160.00
Interest	60.00	60.00	24.00
Insurance	135.00	170.00	30.00
Total annual expense	$2,455.00	$2,810.00	$1,854.00
Cost per day	8.60	10.40	6.50
Cost per mile	.23	.27	.23
Cost per delivery	.067	.075	.085

Poles and Ties in 1911

The Department of the Interior has just issued a report on poles and cross ties used in Canada during 1911. The report as to ties is based on figures received from 51 steam railways and 33 electric roads. The total number of ties purchased in 1911 was 13,683,770. The average cost was 39c each. The lowest cost being 21c for beech, maple and birch, the highest cost being $1.11 for Southern pine. The total number of ties was made up of the following percentages: Jack pine, 39.9 per cent.; tamarack, 19.3 per cent.; Douglas fir, 14.2 per cent.; hemlock, 12.2 per cent.; spruce, 6.6 per cent.; cedar, 5.3 per cent.; oak, 1.1 per cent.; red pine, 0.5 per cent.; chestnut, 0.5 per cent.; western cedar, 0.4 per cent.; birch, 0.1 per cent.; maple, 0.1 per cent.; beech, white pine, poplar, southern pine, elm, black ash, less than 0.1 per cent. The total number of ties purchased represents an increase of 48.5 per cent. over the previous year. About 63 per cent. of the 1911 ties were hewn as against about 70 per cent. in 1910, indicating an increasing popularity of the sawn tie. Steam railroads used 95 per cent. of all the ties purchased,

the number for electric roads being only 585,242. These were made up chiefly of Douglar fir, constituting 55 per cent. and cedar 28 per cent.

During the year 1911 only 206,209 ties received preservative treatment which is about 1.5 per cent. of the total number used.

The statistics of poles purchased in 1911 were obtained from reports from 282 companies made up of 129 electric light and power concerns, 102 telephone companies, 28 electric roads, 19 steam railways and four telegraph companies. These companies were divided into two main classes, first, steam railway, telephone and telegraph; second, electric railways, power and light. This classification seemed best from the fact that steam roads operate telephone and telegraph lines in connection with their railways and many electric roads distribute power and light.

The total number of poles purchased was 585,703 at an average cost of $1.80. The cost of the various kinds of wood were as follows: red pine, $13.16; white pine, $10.70; yellow pine, $9.33; chestnut, $5.25; Douglas fir, $3.79; western cedar, $2.99; hemlock, $1.68; cedar, $1.61; larch, $1.43; spruce, $1.02; jack pine, 89c. Cedar was by far the most generally used, representing about 80 per cent. of the total, with western cedar second and larch third. The use of spruce pole is also increasing, nearly 9,000 being used during the past year.

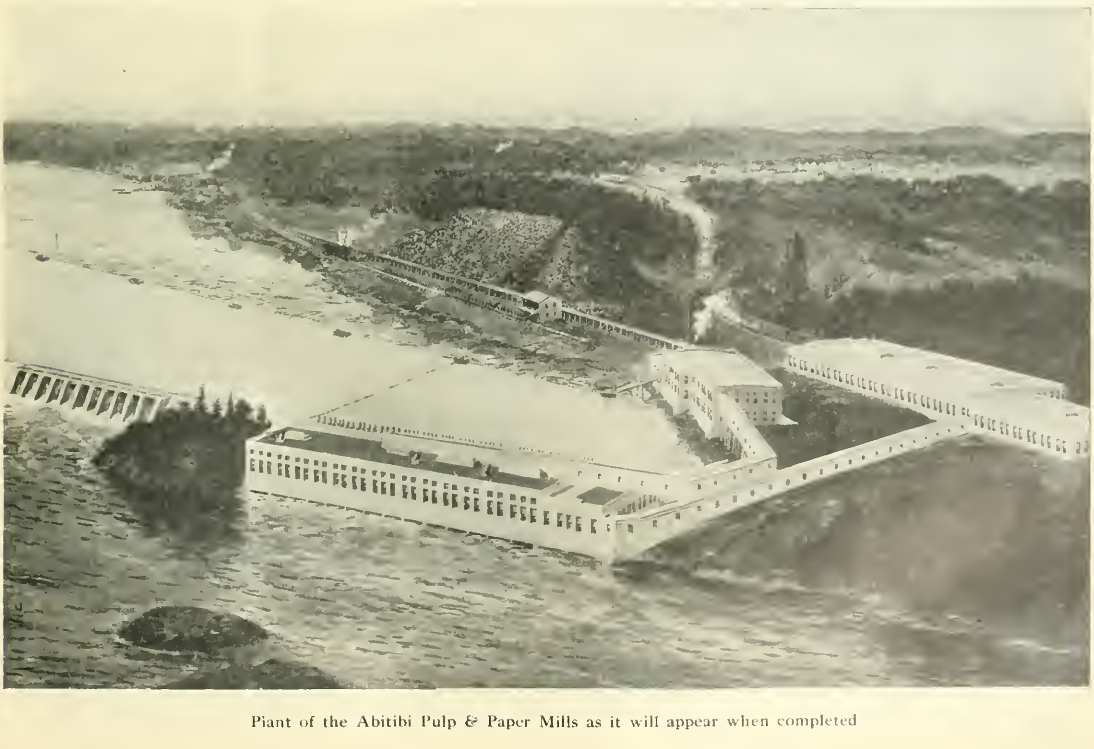
Tables given in the report cover the number of poles, the total cost and the average cost for different lengths of poles. 20 to 25 ft. lengths constitute 58 per cent. of the total and cost on an average, $1.12; 26 to 30 ft. lengths were 17 per cent. of the total and averaged $2.17; 31 to 35 ft. lengths were 3 per cent. of the total and averaged $3.65 each; 36 to 40 ft. lengths were 3 per cent. of the total and cost $4.93 each; 34 ft. and over were 2 per cent. of the total, averaging $8.25 each.

Abitibi Pulp and Paper Mills

Work is now proceeding on the dam and power house of the Abitibi Pulp and Paper Mills, Limited, at Iroquois Falls, Ont. At first a ground wood pulp mill, with a capacity of 180 tons per day, will be constructed; later a chemical pulp plant will be installed, and eventually paper mills will be erected. The company have secured leases of the Iroquois Falls, capable of developing 22,000 horse power at 80 per cent. wheel efficiency; Couchiching Falls, 18,000 horse power; and Twin Falls, 18,000 horse power. At present it is proposed to develop the Iroquois Falls to the extent of 17,500 horse power. Mr. Henry Holgate, who is the consulting electrical engineer, is of opinion that there will be sufficient water all the year for the company's requirements. At present there is a drop of 23 feet at Iroquois Falls, but this will be increased by the contractors to 36 feet. The water will be backed right up to Twin Falls, and up the Black River to Matheson. A branch line of the T. & N. O. Railway is being built, and this will be completed by the end of June.

Of the power to be generated, about 15,000 will be used for running 18 ten-ton grinders, and in addition 3,000 horse power of electrical energy will be utilised. The capacity of the wet machine room will be 200 tons, and in the wood preparing room the slashers will deal with 600 cords per 10 hours, while the barkers will treat some 20 cords per hour. The saw mill will have a daily output of 25,000 feet, and the dry kilns of 7,500 feet per day. A wood working mill, with planers, matchers, etc., also a machine shop fully equipped with lathes, planer and drills have been erected.

The buildings will be completed by December 1st, and



Piant of the Abitibi Pulp & Paper Mills as it will appear when completed

operations commenced in January next year. The plant has been designed by Mr. G. F. Hardy of New York, and the contract let to Messrs. Morrow & Beattie.

Record Results

The Western Canada Power Company, in issuing their annual statement for the year ended December 31st, 1912, briefly reviewed the situation of development and distribution since the company commenced operations at the beginning of the year. During the year 1912 the company procured industrial power contracts to the amount of 20,000 h.p., 13,000 of which was actually connected up at date April 10th, 1913. In addition, a contract has been closed for approximately 6,000 h.p. with the Whatcom County Railway and Light Company, under which supply had already been begun. The report states that early in the year a further contract was completed with the British Columbia Electric Railway Company for an increasing supply of electric power up to 40,000 h.p., and that on April 8th they began supplying power on account of this contract. At the commencement of the second year of operation therefore, this company has contracted for a supply of 65,000 h.p. with about 5,000 more under negotiation and the statement is made by the management that they do not believe that any new hydro-electric undertaking, in building up its business in new territory, has ever obtained better results during the first 15 months of operation.

The hydro-electric plant at present comprises two units located at the upper fall on the Stave River, each unit consisting of 13,000 h.p. at the turbine. The rapid increase in business has led the company to outline the following program of extension, which covers the next seven years, by which date they calculate to have a demand of 94,000 h.p. available with which they will be able to take care of a connected load of approximately 150,000 h.p.

	No. of Units	Demand in Horse-Power
1913	2	24,000
1914	3	30,000
1915	4	40,000
1916	5	54,000
1917	5	60,000
1918	6	74,000
1919	7	88,000
1920	8	94,000

The report further states that the plant of 25,000 h.p. capacity which is now in operation at the upper site was originally constructed so that its capacity could be doubled with an expenditure of about $80 for each h.p. of additional less cost per h.p. so that the total bond debt on the entire development. The second plant can be developed at even property will be less than $130 per h.p. including dams, power houses, main transmission lines and power distribution systems for over 10,000 h.p. developed.

The assets of the company are now placed at $8,339,866, against which there is a bond issue of practically $5,000,000 and a common stock isue of $3,000,000. The management of the company are C. H. Cahan, president; T. J. Drummond, Sir Max Aitken, A. R. Doble, A. H. B. MacKenzie, C. Sweeny, Jno. Hendry, William McNeil, R. F. Hayward. Mr. Hayward is also general manager of the company.

Standard Inspection

The British Columbia Electrical Inspection Society is the title of an organization which has lately been formed at Vancouver composed of city and municipal electricians and inspectors, superintendents and other officials of electrical contracting firms, and representatives of power companies and supply houses. The object of the society is the standardization of inspection work, and the co-operation of the various electrical interests. It covers New Westminster, Burnaby, Point Grey, South Vancouver, and North Vancouver, as well as Vancouver. The first open meeting of the society was held on April 8 and it has been decided to hold bi-monthly meetings from now onward. An address on some interesting electrical subject will be given each month by one of the members.

Mr. C. H. Fletcher, city electrician of Vancouver, has been elected president and the newly elected vice-president and secretary are Messrs. H. Burns and J. W. Cooke respectively, of the City Electrician's department.

It is hoped to later extend the scope of the organization by the addition of members from the cities and municipalities of the interior.

Latest Report on Keokuk Plant

The latest progress report of the Mississippi River Power Company, at Keokuk, Iowa, where thirty 10,000 h.p. water units are being installed indicates that the work is now well under way and that the plant will be turned over to the operating department in June of the present year. The illustrations shown indicate the advanced progress of the work. One of the figures shows a portion of the tail-race, which is now completed, with the draft tube openings. Fig. 2 is a view looking through the low tension bus room of the power house. Fig. 3 is a section of one of the high tension rooms located on the fourth floor of the power house. Fig. 4 shows the steel gates which set on top of the dam spillways. It will be remembered that there are 119 of these gates all operating independently. Fig. 5 is a view of the structures and fittings on top of the power house roof. Fig. 6 shows the towers used on the 110,000 volt line. The similarity between towers used in the Mississippi plant and the towers of the Hydro-electric Power Commission of Ontario, both designed for the same voltages, is very noticeable. The main features of this plant have been outlined in former issues but the following additional data is of interest.

Generators

Four of these units are now entirely completed. The

Portion of tail-race showing draft tube outlets

base and stationary portion is assembled for two more and stators are wound for six in addition. The rotating portion is completely assembled for eleven machines. One of the

Low tension bus room

Section of high tension bus structure

1,000 kw. exciter generators has been erected and connected up.

Transformers

A complete transformer weighs 246,000 lbs., and stands nearly 25 ft. in height. Each transformer is mounted on wheels which rest on hundred pound rails and can be rolled out into the gate room under the crane for repairs. Each transformer has a capacity of 9,000 kv.a. and steps the voltage up from 11,000 to 110,000 volts. Efficiency is 98.2 per cent. Fifty-six gallons of cooling water per minute will be required by each.

H. T. Equipment

The high tension busbars are made of 2 in. iron pipe and are hung from the ceiling by seven-part disc insulators. Immediately below these, are the 110,000 volt oil switches each consisting of three tanks approximately 3 ft. x 6 ft. x 6 ft. The current passes through the roof, through porcelain bushings tested to 330,000 volts. On the roof the current

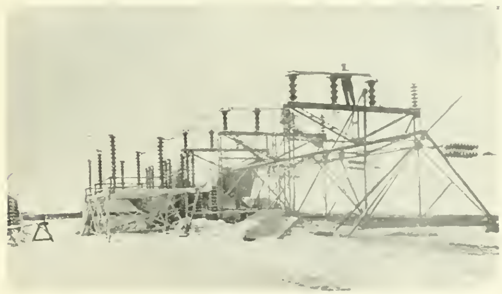
Showing steel gates closing opening above spillway

passes through choke coils and air-break switches to the transmission line. Between choke coils and air switches aluminium lightning arresters have been installed.

Transmission Line

The 110,000 volt transmission line to St. Louis is 144 miles long. It runs on a private right-of-way 100 ft. wide crossing the Mississippi River twice and the Missouri once by long spans of special construction.

Towers are of two types, standard and anchor. The standard towers are 79 ft. in total height with a 20 ft. x 20 ft. base, each one weighing 6,800 lbs. Each leg of these towers is bolted to a reinforced concrete foundation extending 6 ft. below the ground level. The anchor towers are 74 ft. in height, 24 ft. by 24 ft. at the base, and weigh 10,500 lbs. They are designed to withstand a total pull of 50,000 lbs. in the direction of the line. The foundations of the anchor towers extend 8 ft. below the ground level. In the standard line construction spans are approximately 800 ft. and anchor towers are used at all angles, on both sides of railway corners



High tension structure on top of power house roof

and approximately every tenth tower on tangents.

The towers carry seven wires in all. Six, comprising the two transmission circuits are arranged in vertical planes 18 ft. apart on each side of the towers at elevations 50 ft., 60 ft. and 70 ft. above the ground. The seventh is a ground wire mounted at the apex of the tower.

The current conducting wires are composed of nineteen strands of hard drawn copper and are $\frac{5}{8}$ in. in diameter with an area of 300,000 c.m. This cable has an ultimate strength of 14,000 lbs. and is strung so that at zero degrees F. with a 60-mile wind and a coating of ½ in. of ice the tension will not be more than 7,065 lbs. The ground wire is a galvanized seven-strand cable, ½ in. in diameter, of Siemens Martin steel. It has an ultimate strength of 11,000 lbs.

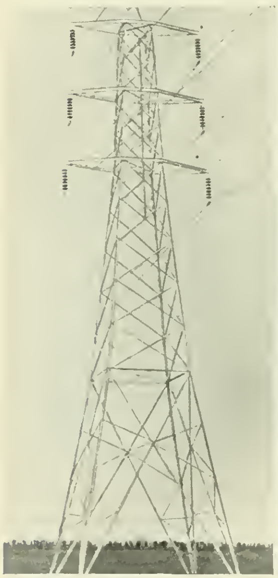
The insulators which support the high voltage conductors consist of seven corrugated porcelain discs each 10 in. in diameter, connected by malleable iron fittings, making a completed insulator unit 3 ft. in length tested to withstand a voltage of 440,000. The insulator is held to the tower and the conductor to the insulator by fittings of open hearth steel. The wire clamp consists of two plates into each of which a wavy groove, flaring at the ends, has been pressed so as to

better hold the wire. At anchor towers conductors are dead-ended through two parallel strings of eight units each as shown in one of the illustrations herewith.

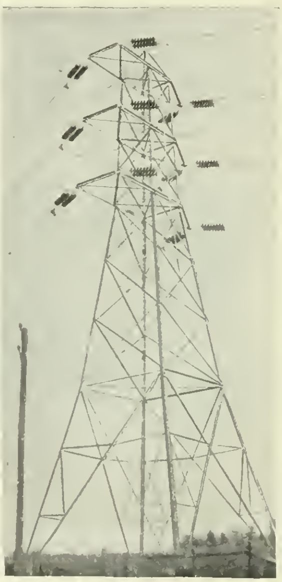
The river crossings are made by one or more long spans varying from 2,000 ft. to 3,200 ft. The two circuits are separated at these crossings and each, together with a ground wire, is run on a separate line of towers. These towers vary in height from 60 ft. to 231 ft., and are set on massive concrete foundations resting either on bed rock or on piling.

The conductor used on all of these river spans consists of a 5/8 in. core of special high tension steel with an outer stranding of twenty copper wires, giving a total diameter of 7/8 in. Each circuit has a ground wire the same size as the conductor core. The ultimate strength of the conductors is 52,000 lbs. The special insulators required to hold up these long spans are made up of six strings of standard insulators inter-connected in such a way that the pole is evenly distributed. These insulators have an ultimate strength of 60,000 lbs. The conductors are in general strung to give a minimum clearance over navigable channels of 60 ft. and over other points of 30 ft.

In the erection of the tower line, the towers were assem-



Standard Tower



Special anchor tower

bled complete on the ground and raised on a temporary hinge fastened to two of the foundation piers, by means of a gin pole and a team of horses. When the towers were erected each conductor was strung from one angle tower to the next by hanging pulleys from the angle towers at points where the insulator would ultimately be placed, threading the cable through these and pulling it up for the entire distance between anchor towers. The line was brought to the proper tension by means of a dynamometer and fastened to the dead-end insulators at each end. A stirrup support was then attached at each intermediate tower, the conductor raised from the pulley by it, the pulley removed and the insulator hung and bolted to the cable.

A telephone line parallels the transmission line and is built on 30 ft. cedar poles. There are two No. 8 telephone conductors and a ground wire for lightning protection.

Errors In Transformer Tests

A Discussion of the Principal Sources of Error and the Best Methods of Avoiding Them*

In order to obtain accurate results in making transformer tests, it is necessary to make all measurements and tests very carefully, and to be able to pick out and eliminate all errors or sources of error. Some errors can be avoided, while others are of such a nature that they must necessarily be included in the measurements and can be corrected later. Only those errors or sources of error that have an appreciable effect upon the results should be eliminated, since to include all would be introducing laboratory methods into commercial testing, thus unreasonably increasing the time and cost of making tests without securing any useful results.

Instruments

Instruments should be selected to give a good scale deflection, as small errors in observation give a greater percentage error for small deflections than for large. They should be calibrated at regular intervals, and if at any time it is suspected that they have been subjected to abnormal usage, their calibration should be checked at once. Care should be taken that they are not used beyond their capacities, as in this way the calibration may be changed, or they may be damaged.

It is best to avoid the use of instrument transformers wherever possible, but when it is necessary to use them, they should be calibrated at the proper frequency, with loads equivalent to the instruments with which they are to be used.

Instruments should be located so as not to be influenced by stray fields. Neglect of this precaution may, in many cases, result in the introduction of serious errors. Careful note should be made of the way in which the instrument is connected in the circuit so that, when necessary, correction can be made for the losses that occur within the instrument itself.

Tests

Complete tests on transformers ordinarily include:
Ratio,
Polarity,
Resistance,
Iron loss and magnetizing current,
Copper loss and impedance,
Heat run,
Over-potential test,
Insulation test.

Each of the above tests will be considered separately.

Ratio

There is little difficulty in measuring the ratio of large power transformers. The number of turns is comparatively small and almost any convenient voltage may be used. Great care, however, must be used in order to get the correct ratio of small high-voltage transformers, and particularly those to be used with instruments. With the latter it is necessary that the ratio be correct within very narrow limits or the accuracy of the instrument readings will be seriously affected.

In measuring the ratio of small transformers with voltmeters in the ordinary way, it is necessary to apply practically normal voltage in order to secure accurate results. If only a small percentage of normal voltage be used, the drop due to the load of the measuring instrument alone will introduce considerable error. The most satisfactory way of measuring the ratio of such transformers is by paralleling them with standards of known ratio that have been specially de-

*By W. M. McConahey and C. Fortescue before the I. E. E.

signed with a large number of taps covering a wide range with very small steps. With a testing set of this kind, the ratio can be determined with a close degree of accuracy.

Polarity

The polarity of single-phase transformers is easily measured and requires no special precautions.

The polarity of three-phase transformers involves the relations between the phase displacement and the direction of the voltages at the terminals of the high-tension and low-tension windings, and the necessary measurements should be made to determine these relations. This can be best done by connecting one of the high-tension to one of the low tension terminals and impressing a convenient three-phase voltage across either winding and measuring all the combinations of voltages among the six terminals. From these, and a knowledge of the connections of the windings (whether delta or star), a voltage phase diagram showing the polarity can be constructed easily.

Resistance

The utmost care should be used in measuring resistance in all cases where it is used as a basis for determining the temperature rise. In measuring the cold resistance, it is just as important to know the actual temperature of the winding at the time the measurement is made, so as to get a correct basis from which to calculate the temperature at the end of the heat run.

Where the transformer is standing in the air, several thermometers should be placed in close contact with the coils at several points and, before making the measurement, time enough should elapse so that the temperature of the coils will be within a degree or two of that of the surrounding air. In order to secure the best results, the measurements should be made when the air temperature is steady, or at least showing very little fluctuation.

Where the transformer is in oil, it should be allowed to stand until thermometers show a practical agreement between the temperature of the windings and that of the oil.

In making the measurements, the readings should be taken as quickly as is consistent with accuracy, and the current should be small enough to avoid any appreciable heating of the windings. The temperature of the windings as shown by the thermometers, should be carefully noted at the same time.

Resistances can be measured most satisfactorily with a Wheatstone or a Kelvin bridge, the former being used for the higher, and the latter for the lower resistance. The resistance to be measured is generally known approximately, so that the bridge can be set fairly close to the correct point beforehand, and the time taken in getting the correct setting, when measuring the resistance at the end of the heat run, can be made very short.

Iron Loss and Magnetizing Current

The iron loss is a function of the frequency, the voltage and the voltage wave form. The frequency and voltage can be determined easily, but this is not true of the wave form.

Since the iron loss may be appreciably decreased or increased, according to whether the voltage wave form is peaked or flattened it is very desirable to have some satisfactory method of getting the proper correction to be applied to the wattmeter reading, so that the corrected result will be the same as would have been secured if the voltage wave had been of the sine form. It is possible to arrive at this by taking an oscillograph curve of the voltage wave when the iron loss is being measured, and analyzing and comparing it with the true sine form. This is a tedious operation, and one not suitable for commercial testing. A very satisfactory way of making the correction easily and directly is by using the iron loss voltmeter. This instrument gives at once the necessary correction without any calculation, and is therefore exceedingly useful for making iron loss measurements.

If the generator used in measuring the iron loss is large enough so that it is only lightly loaded, and if its voltage wave closely approximates the sine form, there will be very little wave distortion, and the correction to the wattmeter reading will be negligible. In order to make sure of this, however, it is best to use the iron loss voltmeter in all cases.

In a transformer having a large magnetizing current, the I^2R loss in the winding during the iron loss measurement may be appreciable. This loss is constant at all loads, and may therefore be properly included in the iron loss.

Due to the voltage drop in the primary winding, the induction in the iron will be slightly decreased in going from no load to full load, thus tending to decrease the iron loss slightly. On the other hand, the path of the leakage flux about the windings lies partly within the iron, and this may tend to increase the iron loss under load. On the whole, the net difference is negligible, and the iron loss may be considered the same at full load as at no load.

Copper Loss and Impedance

In making copper loss and impedance measurements, care should be taken to see that the frequency is correct and that practically no increase takes place in the temperature of the windings during the measurement.

The frequency affects the eddy current loss in the copper, and also the reactance, which varies directly with it.

Since the copper loss varies with the temperature of the windings, correct results can only be secured by maintaining the temperature at a practically known value during the measurement. This is secured by placing thermometers in close contact with the windings and letting them remain there until they show a steady temperature, and then taking the readings as quickly as possible.

Knowing the temperature of the windings at the time the readings are taken, the copper loss for any other temperature can be calculated with very little error, except where the eddy current loss is very large. In the latter case, it is best to take the copper loss at or near the temperature desired.

Distorted wave form of e.m.f. has very little effect upon copper loss or impedance, unless the distortion is very bad.

Heat Run

The heat run is made chiefly to ascertain the temperature rise under given load conditions.

In getting the temperature rise by resistance, great care must be taken in making the measurements, cold and hot, as discussed under "Resistance." Care must also be used in getting the temperature of the cooling medium or water.

For oil-insulated water cooled transformers, the surrounding air has some effect upon the cooling, but it may be neglected. The temperature of the ingoing water is taken as the basis for calculating the temperature rise. The source of the water supply is generally such that its temperature remains practically constant during the heat run, so that the principal points to be observed are to see that a thermometer is placed in the ingoing water; that its readings are carefully recorded at regular intervals; that the flow of water is kept constant, and that practically an equal amount of water flows through all parallel coils. At the end of the heat run, the flow of water and the power should be shut off at as nearly the same instant as possible.

For air-blast transformers, the temperature of the air in the pit is the basis for calculating the temperature rise, and it should be maintained at a practically steady value during the heat run and particularly near the end. The dampers should be adjusted to give the proper flow of air, which is generally such as will show a temperature rise of 11 or 12 deg. in passing through the transformer. In shutting down

at the end of the heat run, the air blast and the power should be shut off at the same instant.

In making a heat run on an oil insulated self-cooling transformer, its temperature is determined by that of the surrounding air in the room. The room temperature is always a more or less variable quantity and hard to control, and should therefore be given careful attention. The room should be well ventilated, but strong air currents should be avoided. A steadily rising or steadily falling air temperature towards the end of the heat run introduces an error into the determination of the temperature rise that is not easy to eliminate. A satisfactory way to correct for the error is to have an unloaded transformer standing nearby and using the variation in the resistance of its windings as a basis for the correction.

Oil-insulated self-cooling transformers, when on heat run, should be separated by a space approximately equal to the width of the tanks. Thermometers should be placed about the transformers at a height that can be read conveniently, and far enough away not to be influenced by the radiation of the heat. This will generally require a distance of six feet (1.8 m.) or more from the transformers.

It has been the rule heretofore, to make a correction of one-fourth of one per cent. in the temperature rise, as calculated from the resistance, for each degree of variation of air temperature from the standard of 25 deg. Experience, however, seems to show pretty conclusively that this is in error and that, for all practical purposes, no correction should be made.

Insulation Test

Before making this test, all the terminals of the high-tension winding, and also all those of the low-tension winding, should be connected together. Also, while testing between the high-tension and low-tension or ground, the low tension should be connected to ground. Otherwise, in testing between the high-tension and ground, dangerous stresses may be set up between the low-tension and ground far in excess of any that may occur in service, and a breakdown may result.

In making tests of about 50,000 volts or more, a spark gap should always be used. Because of the voltage rises that takes the ratio of primary to secondary voltage of the testing transformer cannot be taken as equal to the ratio of turns, so that, without the spark gap, there is no measure to the actual testing voltage. A high resistance, sufficient to limit the flow of current to a small amount, should be placed in series with the gap.

Air bubbles in the oil about the transformer may be a source of serious trouble, and therefore, if there is any indication of their rising to the surface of the oil, the insulation test should not be applied until they cease. The test should be made immediately following the heat run, while the transformer is warm.

Over-Potential Test

This should be the last test applied. With high voltage transformers, in particular, care should be taken to see that all terminals, connectors, etc., are in proper place. The frequency used should not be higher than is necessary to keep the magnetizing current within reasonable limits.

It is necessary in this test, also, that there be no indication of air bubbles in the oil.

Vancouver Island Telephones

To get thoroughly in touch with conditions on Vancouver Island, officials of the B. C. Telephone Company spent a week recently in making a tour of the Island, visiting all the points where the company operates. Development has been considerable in and around Victoria, in the territory between Victoria and Nanaimo, at Alberni on the west coast, and north in the vicinity of Courtenay. As a result of the extended trip, improvements are planned at nearly all the places visited.

In the party were Messrs. George H. Halse, secretary-treasurer; F. J. MacGougan, commercial superintendent; George McCartney, superintendent of construction, and E. P. Labelle, plant engineer.

At Gordon Head, four miles out of Victoria, a new exchange is to be installed, and also at Cobble Hill, about midway between Victoria and Nanaimo, on the line of the E. & N. Railway. Service is also to be given Mount Tolmie, and an extension of the Victoria city system is to be made for this purpose. Duncan is also to have extensions made to the outside plant, and considerable work will be done at Nanaimo. Parkerville, north of Nanaimo, is progressing, and a new switchboard is now being manufactured in the company's warehouse at Vancouver, to be installed there. Additions are to be made to the system at Port Alberni. Conditions were found fairly good at Union Bay, Cumberland, Courtenay and Comox, and at Grantham, an agricultural district north of Courtenay, a demand for telephone service has been made.

While on the Island, the party of officials covered the whole of the route of the new toll line between Nanaimo and Victoria, which will be the land end of the new line between Victoria and Vancouver, in connection with the cable to be laid across the Gulf of Georgia in June. Three gangs are working on the land line on the Island, one out of Victoria, and the other at Nanaimo working south. This line will be ready when the cable arrives.

The poles are on the ground for the span across Nanaimo harbor. These will be 150 feet in height, and are in one piece, and will hold the aerial span between Nanaimo and Newcastle Island. There will be a stretch of a mile across this island to where the cable will land.

Personal

Mr. W. J. Baskerville will fill the late Mr. Brophy's place on the board of directors of the Ottawa Electric Company.

Mr. Lawford Grant was recently elected a director of the Insurance & Brokerage firm of E. M. Sellon & Company, Limited, Montreal.

Mr. Charles F. Gray, consulting electrical engineer, Winnipeg, announces that owing to increasing business, he has moved to larger quarters in the Union Trunst Building, of that city.

Mr. E. A. Graham who was recently appointed electrical engineer of the Winnipeg Electric Railway Company has resigned that position, being forced to go south on personal business matters.

Mr. Gerald H. Moore has been appointed resident engineer of the Canadian British Engineering Company, Limited. Mr. Moore is a son of the late Col. Moore, formerly chief of mounted police in the Winnipeg district.

Mr. Thomas Ahearn, president of the Ottawa Electric Railway Company and Mr. James D. Fraser, secretary-treasurer of the company have returned from a three weeks trip to Havana, and the Panama Canal zone.

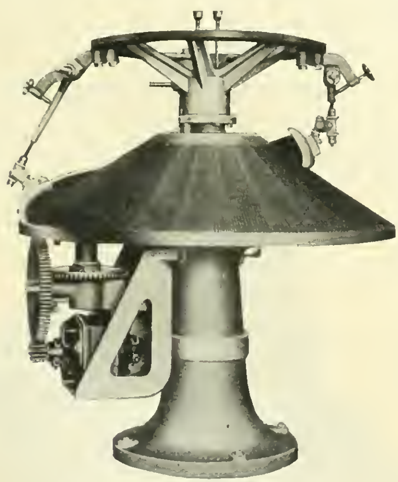
Mr. Redmond Quain has been appointed on the board of directors of the Ottawa Electric Railway Company to succeed the late Mr. George P. Brophy. Mr. Quain, who is 52 years of age was one of the pioneers of the street railway in Ottawa and was on the board of directors during the first few years of the company's existence. He has acted as auditor of the company for several years.

The Diverse Uses of the Electric Motor

It is applicable to every phase of every industry and trade—It means simplicity, efficiency, economy and continuity of service—It is the basis and symbol of Twentieth Century Advancement

It is generally recognized that the electric motor is supplementing every other kind of drive in every kind of manufacturing industry and in the utilization of these manufactured products, but it is possibly not recognized to how great an extent the advantages possessed by motor drive off-set any disadvantages of inconvenience to change or expense incident thereto. A study of this subject, the applicability of electric drive, indicates that it is a practical impossibility to suggest any kind of moving machinery to which motors of one size or another or one type or another are not applicable. It is with this idea in mind that the present article, which is an attempt to classify in a general way the uses of electrical motors throughout the whole field of their applicability, has been prepared. It is not claimed however, that mention will be made of every instance of applicability as a complete discussion of the situation would require more space than is available in a publication of this kind. That this latter statement is true only emphasizes once more the universality of the electric motor in 20th century industrial, commercial and domestic life.

In the following pages motor applications are not considered in any sense in the order of their relative importance or size. The article is primarily intended to point out the wide applicability of the small motor. To render the article more valuable as a reference the industries or applications have been arranged in alphabetic order though the reproductions referring thereto are not necessarily in the same order.



Motor driving loaf-rounding machine

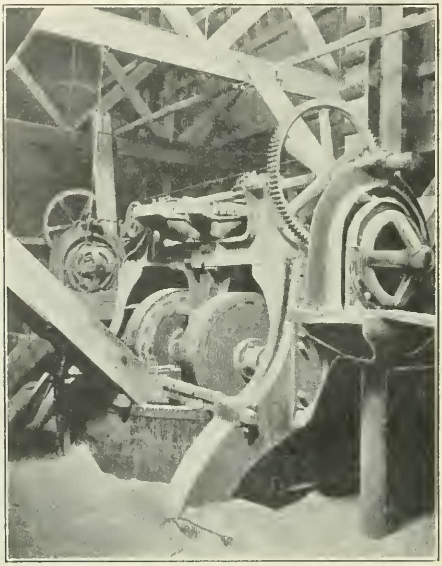
The superior applicability of the electric motor to every form of drive in practically every form of industry having been recognized therefore, it remains largely to satisfy the manufacturer that convenience, operating costs, increased factor of safety, increased quantity of work, improved quality, etc., are also factors associated with electric drive. Possibly the one factor in this list which it is most difficult to defend is that of cost but even here the efficiency of the modern motor and the advantageous power rate the manufacturer is able to demand in the majority of cases makes for an operating cost which other forms of energy can very rarely compete with.

Of course in the matter of current costs there are two sides to the question. The manufacturer is anxious to use his motor equipment as short a time each day as possible and to install the smallest capacity possible. On the other hand the central station is anxious to see the greatest possible amount of energy and where he finds that a certain class of customer does not use more than from 5 to 10 per cent. of his installed capacity on the average, it is reasonable to expect that he will not be particularly anxious to push this class of business. And right here we may have the reason why motor equipment which appears to possess so many advantages has not been installed by a number of manufacturers who would evidently gain financially and otherwise by their use. It is simply because the central station has not felt it to be particularly to his own interest to enlarge this class of customer.

Motors driving hooping and pitching machines

Often also it has been difficult to give anything like a fair estimate to a prospective customer of what his power is going to cost. Figures covering data of this sort have not been available and so it has not been possible to assure any class of manufacturer that the power he would require in his business would only be 10 per cent. or 15 per cent., or as the case may be, of his total manufacturing costs. In this connection it is of interest to note that under recent date the National Electric Light Association compiled a list of the load factors of a number of industries, which we print herewith. It is not intended that these figures should be taken to represent universal conditions as these would vary quite widely between two points, but it will at least blaze the way towards obtaining more accurate results in the future. Use may be made of this table in the following way: —Suppose the load factor of any particular industry is 15 per cent. It is easily possible to obtain from any of the manufacturers who supply motors for this particular industry just what capacity of motor would be required to cover all the machines in use. Suppose in this case it is 400 kw.

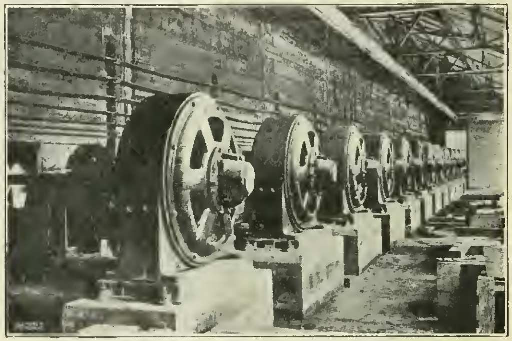
At 15 per cent. load factor this means a continuous 60 kw. load for (say) eight hours a day or a total of 480 kw. hours. At (say) 2c per kw. hour, energy will cost $9.60 per day, or per year of 310 days slightly less than $3,000. If now the total manufacturing costs are known to any manufacturer he can obtain the percentage cost which his power represents of the total cost of manufacturing his product. As being of interest in the working out of results of this kind the table of average load factors as mentioned above is reproduced herewith.



Brick making—C.G.E. motor driving 5 dry pans

Average Load Factors for Different Classes of Service

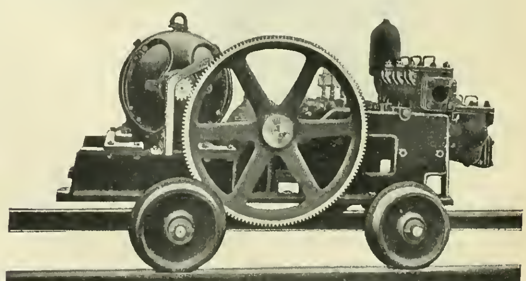
Bakeries, 12; bed manufacturing (brass and iron), 20; belt manufacturing, 10; blacksmith shop, 15; boiler shop, group, 18; boiler shop, individual, 8; bookbinders, 9; boots and shoes, group, 25; boots and shoes, individual, 17; brass finishing, 25; breweries, 45; broom manufacturing, 15; brush manufacturing, 7; bottling works, 10; butchers, group, 15; individual, 9; can manufacturing, 30; candy manufacturing, group, 18; candy manufacturing, individual, 9; carpet cleaning, 15; carpet weaving, 17.5; cement mixing, 10; chemical works, 11; cigar boxes, 6; clothing manufacturing, 18; coffee roasting, and grinding, 7; coopers, 5.5; creameries, 20; diamond cutting and polishing, 13.5; dye works, 15; electroplating, 20; electrotypers, 20; feather cleaners, 12; feed grinders, 6; fertilizer manufacturing, 75; flour mills, 23; forge shops, 10; foundries, brass, 6; foundries, group, 15; foundries, individual, 9; glass grinding and polishing, 17; glove manufacturing, 25; glue manufacturing, 15; grain elevators, 10; grocers, wholesale, 15; harness shops, 10; hoisting and conveying, 10; ice cream manufacturing, 20; ice making, 30; ink making, 23; jewelry, 15; knitting mills, 25; laundries, 20; leather, 8.5, lithographing, 10; machine shops, group, 20; machine shops, individual, 8; marble workers, group, 18; marble workers, individual, 10; mattress manufacturing, 6; newspapers, group, 18; newspapers, individual, 8; ornamental iron works, 17; paint manufacturing, 25; paper box manufacturing, 18; pipe threading and cutting, 8; plumbing, 20; pottery manufacturing, 13; printing (job), group, 18; printing (job), individual, 7; printing (magazine), 20; packers, 25; refrigeration, 50; restaurants, 20; rock crushing, 18.5; rubber manufacturing, 9.5; saw manufacturing, 30; screw manufacturing, 30; seed cleaners, 18; sheet metal workers, group, 15; sheet metal workers, individual, 10; silversmiths, 7; spice grinding, group, 12; spice grinding, individual, 8; soap manufacturing, 20; stone working, 6; structural steel manufacturing, group, 20; structural steel manufacturing, individual, 12; tannery, 20; telephone stations, 25; textile mills, 25; tinsmiths, 10; tobacco, 14; twine mills, 30; woodworking (general), group, 18; woodworking (general), individual, 6; woodworking, furniture, 28; woodworking, box making, 10; wall paper manufacturing, 12; wagon builders, 5; wheelwright, 9.



Row of 12 C.G.E. motors in Cement mill

Electric Equipment in Bakeries

The progressive modern baker requires a model plant in which cleanliness, efficiency and economy are combined to the highest degree. Such a plant must have electricity because the simplicity, convenience, economy and cleanliness of the electric system of driving and lighting are unequalled. As in other manufacturing industries the use of electricity means economy of space, economical location of machinery, better lighting arrangements, greater safety to operators, lower fire hazard, less time lost in starting and stopping machinery and lower operating costs because the machines cost nothing when not in use. Among the applications of electricity are dough mixers requiring only a small motor of a few h.p., dough dividers requiring also only a small motor, dough handling outfit, cake machine requiring



C.G.E. motor driving portable mine pump

approximately one h.p., loaf rounder requiring only a small motor, loaf moulder, stacking machine, etc. Even if the machines were not originally designed for electric drive, it may later be installed either through belt or gears at very little expense and without any increase in space.

Bakers using electric motors report very little, if any expense for repairs. The cost of power is scarcely that of doing the same work by hand. Only the power actually used is paid for and a large number of bakers operating machinery in shops turning out from 500 to 1,000 loaves of

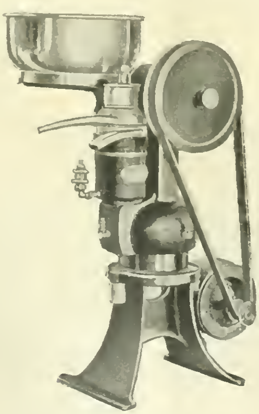
C.G.E. motors delivering concrete at Gatun Locks

bread per day have found that the adoption of a motor driven dough mixer has effected a saving of from \$10 to \$12 per week for this item alone.

The interesting process of bread making in a typical electrically driven bake shop is as follows:

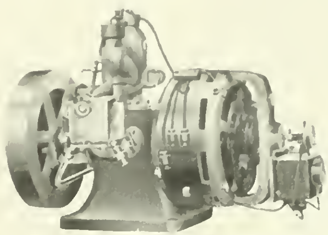
"The flour is unsacked into a bin in the cellar and elevated by a flour lifter and conveyor in the large hopper above the dough mixer, the hopper being suspended from a lever connected with the scale beam so that it can be weighed at any time.

A dough mixer, dough brake, and a flour sifter and conveyor are grouped on one 5 h.p., 1,200 r.p.m. motor. The dough divider is usually driven by a 2 h.p., 1,200 r.p.m. motor. The dough is transferred to this machine from the rising



C.G.E. motor driven separator

tubs and, with each revolution of the wheel, four loaves of any desired weight are punched out and dropped upon the delivery belt. The weight of the loaves may be regulated at will by a simple adjustment of the machine. This machine has an ingenious arrangement of small hoppers which sift flour in the dough at the proper intervals to avoid any tendency of the dough to stick. The belt, upon which the loaves drop, consumes one minute in making one-half a revolution, i.e., one minute after a loaf drops upon the belt it is delivered to the moulding machine at the other end of the

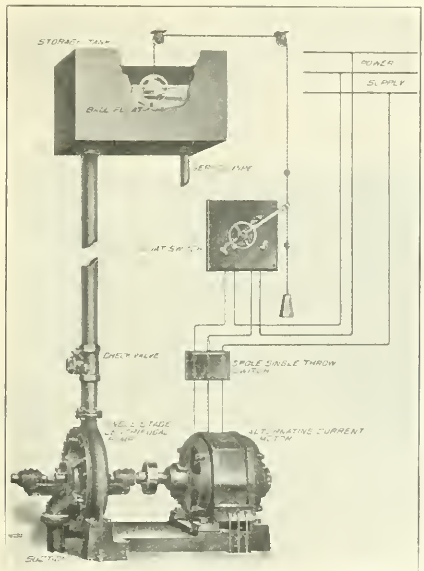


C.G.E. 1 kw. gas-electric generator

table, thus allowing the loaves to recover from their compression.

The loaf moulder is driven by a 2 h.p., 1,800 r.p.m motor which is also geared so as to drive the delivery belt. This moulding machine kneads the loaves exactly as the old-fashioned baker did, turning them twice from end to end, then twice from the side and finally rolling them around the big wheel at the bottom, where they come up and roll into the pan on the shelf from whence they are carried to the oven. This machine is also equipped with a flour sifter to keep the dough from sticking."

The estimated consumption of current for a modern



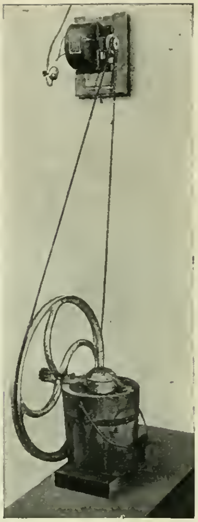
C.G.E. motor operating farm water system

bakery of a capacity of 40,000 loaves daily in addition to several hundred pounds of pies and cakes is approximately 1000 kilowatt-hours a month.

Brewing Industry

The manufacturers of beer and malt are now employing electric drive quite extensively as a means of decreasing the cost of production and at the same time improving the

C.G.E. motor operating corn-cutter and silo filler

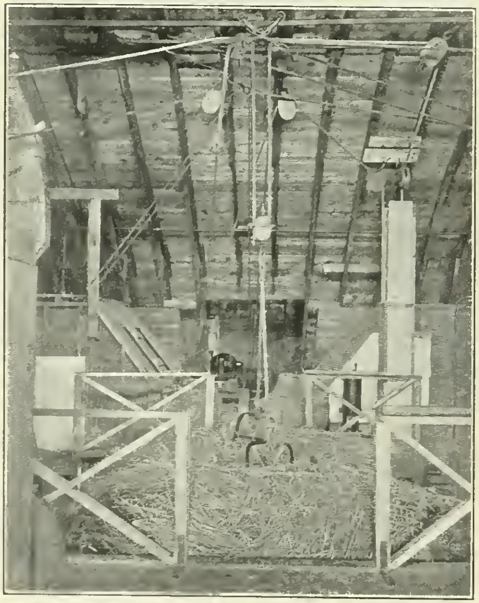


Freezer, motor driven

quality of the product. The application of electric motors to the various machines has enabled the manufacturer to obtain more sanitary conditions and better location of machinery for the successive operations. In almost every installation the individual system of drive has been adopted even for the small power machinery required in the bottling department, thereby insuring maximum flexibility with minimum power requirements.

Among the uses to which motors can be put in this industry is the operation of refrigerating machinery, pumps, elevators and conveyors, mash tub, keg and barrel washer, bottle filler, crowning machine, barrel hooping and pitching machines, chip washer, pasteurizing and labelling machines, bottle washer, malt cleaner and grinder, etc. A typical installation is represented in the following table:

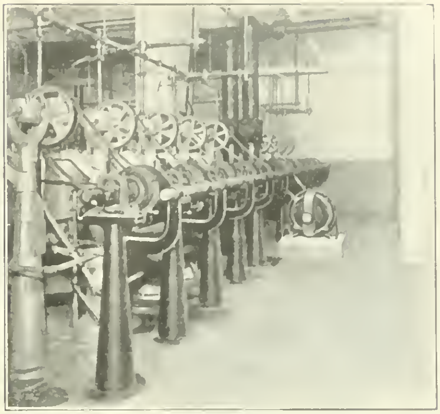
Machine	H.P. of Motor	Group or Individual	No. of Motors
Washing machine	7½	Indiv.	1
Tank room agitators	5	Group	2
8 by 8 air compressor	15	Indiv.	1
Machine shop	5	Group	1
Centrifugal pump	15	Indiv.	1
Mash tub	15	Indiv.	1
Mash conveyor	2	Indiv.	1
Mash pumps	2	Indiv.	1
Malt cleaning and rolling	7½	Indiv.	2
Blower for grinder	1½	Indiv.	1
Beer pumps (4)	5	2 groups	2
Barrel shop	2	Indiv.	1
Bottling works	7½	Group	1
Mangle	2	Indiv.	1



C.G.E. motor operating hay and straw fork

Battery driven motor farm truck

C G.E. mtoor driving grain separator



Ice cream manufacture by motor

Triplex pump	20	Indiv.	1
Centrifugal pump	10	Indiv.	1
Carpenter shop	15	Group	1
Forge fan	2	Indiv.	1
Elevator (2 ton cap.)	15	Indiv.	1
Mash dryer	10	Indiv.	1
Grain elevator	5	Indiv.	1
Centrifugal pump	5	Indiv.	1
Centrifugal pump	15	Indiv.	1
Ice hoist	5	Indiv.	1

Brick Plant

Though the art of brick making is among the oldest of established industries, it is only within the past twenty years that the introduction of power-driven clay working machinery has revolutionized the art and given it its proper rank among the world's industries. It is probable there are now more than 100 varieties of brick manufactured and that the total output on this continent is in the neighborhood of 3,000,000,000 per year. This result has been obtained only through the aid of the electric motor.

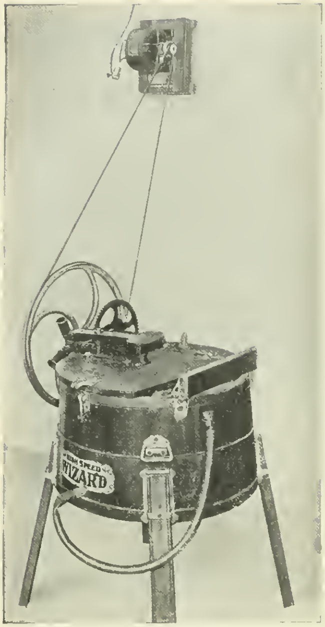
With motor drive any individual machine or group of machines can be operated independently of the rest. Often in brick plants the points of application of power are widely separated necessitating make-shift methods or the installation of wasteful and inefficient non-condensing steam engines. Excavating shovels and drainage pumps at the clay pits, ventilating fans in the dry house and the brick machines proper invariably require separate sources of power unless a centralized system of electrical distribution is employed. With electric drive additional motor driven units can be installed from time to time and the capacity of the plant increased without reference to existing line shafts and belting problems. Electric drive is without question the cleanest, cheapest, safest, most flexible and most efficient method of distributing and applying power that has yet been devised, largely because the logical and economical sub-division of motive power in units of suitable capacity for any and all requirements is an advantage possessed by no other system of power distribution.

Among the uses to which small motors may be put in the brick manufacturing industry are the operation of dry pans, sanders, conveyors, fans, bucket elevators, pug mills, augers, tempering wheels, excavating shovels, hoists, granulators and pumps.

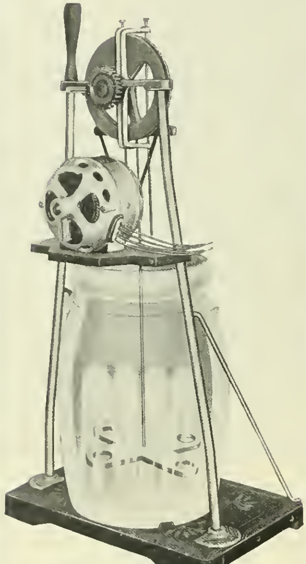
Accurate figures covering cost of electrical operation are difficult to obtain owing to the widely varying factors influencing production. Records from several plants with a daily capacity of from 50,000 to 100,000 soft-mud, sand mould-

Kendrick & Davis utility motor

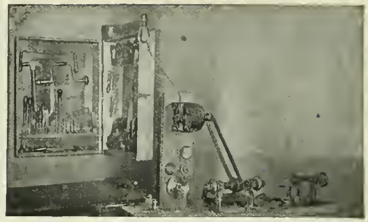
C.G.E. motor operating farm workshop



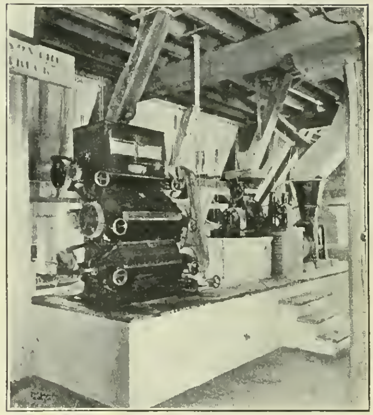
Can. West. motor operating washing machine



Century motor operating churn

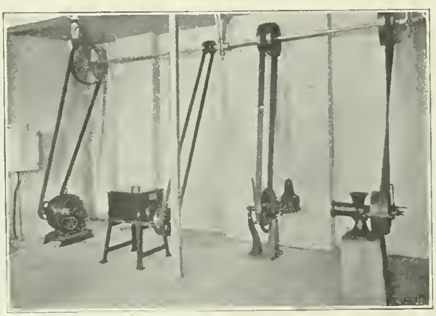


C. W. utility motor in workshop



C.G.E. motor driven farm grist mill

ed bricks, indicate a fair average of 15 to 20 moulds of six bricks each per minute or from 90 to 100 bricks per kw. hour for all electrical power consumed. Plants using the stiff-plastic method show approximately the same output per kw. hour expended. One plant of 156,000 daily capacity shows a power consumption of 1740 kw. hours per day for its auger brick machines. Another plant with a daily capacity of 200,000 common bricks shows for two consecutive months an average monthly output of 4,700,500 bricks at an average expenditure of 45,600 kw. hours in driving its auger machines. Where the change from steam or other form of mechanical power has been made, a saving in operating expense



C.G.E. motor group drive on farm

of from 20 to 30 per cent. has often been effected. The total power required including auxiliary devices varies from 12 to 18 kw. hours, but a conservative estimate of power required by pug mills and augers is about 1.5 h.p. per thousand bricks per 10-hour day or 11 kw. hours per thousand bricks produced.

Cement Plants

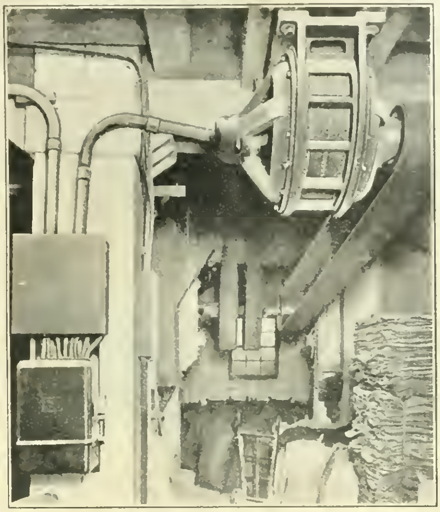
There are certain inherent requirements in the manufacture of cement which establish the value of electric drive over all other classes of prime mover. Under normal conditions cement mills operate 24 hours a day for 7 days in the week and the mill must be kept in practically continuous production. Among the advantages of electric drive may be noted the following:—(1) With individual drive the shut down of any one machine need not affect the operation of any other machine. (2) The general lay out of the plant, to be most economical, must be determined solely by the relative locations of the quarries, the storage bins, the best location of the machinery and space available for extensions. This is best regulated through the use of electric motors. (3) A check can be more easily kept on the cost of manufacture. (4) Most cement machinery starts under a heavy overload and some are liable to short overloads during operation. This condition can be best cared for with electric drive. (5) Since the driving of cement machinery does not require any particular mechanical skill it is important that a form of drive of the same nature be adopted, hence rugged motors of a special type for this class of work are best suited to the conditions. One of the cuts reproduced herewith shows a number of motors, twelve in number, driving raw material tube mills in a large cement plant. These motors are coupled through flexible couplings to the counter shaftings of the mill, necessitating only one gear reduction. The concrete wall separating the motors from the mills secures an unusually clean motor room.

Electricity in Coal Mines

When it is considered that the yearly total production of coal on this continent approximates 600,000,000 tons, it is evident that the power requirements of the industry repre-

sent an expenditure of such proportions as to justify a most careful study of all factors entering into the cost of operation of the various types of machinery required in coal mines.

The use of electricity in coal mining has shown a rapid expansion during the last two or three years, due to a number



C.G.E. motor in flour mill

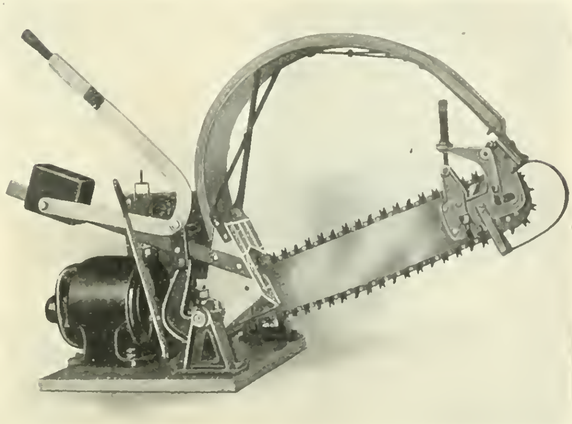
of causes:—increased efficiency of electrical machinery; attention given by manufacturers to the needs of this particular industry; appreciation by mining engineers of the possibilities of electric drive; a marked success of the earlier installations; the operation of mines in localities not suited to other kinds of power operation.

The Electrical News has, from time to time, pointed out the notable increase in the use of electric drive in mining operations and has endeavored to impress the value of this type of prime mover to an industry to which it seems to be peculiarly adaptable. The use of electricity eliminates the necessity for long lines of steam or air piping which are expensive to install and maintain. For these conditions electricity substitutes a simple and flexible system of power transmission by means of electric conductors which can be easily installed and extended to meet change requirements, which are not affected by temperature changes and are not liable to mechanical injury due to conditions peculiar to mines. The much smaller space required is also in many instances an important factor.

Perhaps in no phase of mining operations is electric drive more valuable than in the operation of mine locomotives. Electric drive for mine haulage possesses advantages of high efficiency, mechanical strength, dependability, simplicity of control and compactness, the latter characteristic being of extreme importance. Among the other uses to which electricity may be put may be mentioned:—the drive of friction hoists, stationary and portable pumps, water hoists, bucket conveyors, coal cutting machines, air compressors, coal extractors, etc.

Excavation and Construction Work

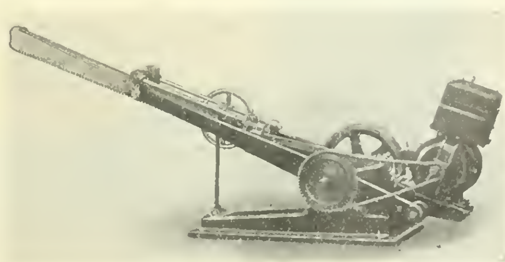
The amount of construction work being carried on at the present day is limited only by the amount of capital available and the limitations of labor. It is therefore evident that the system of power application adopted will have an important bearing, not only on the cost of construction but on the amount of work that can be completed in a given time. In some plants much of this work has in the past depended on steam drive combined with compressed air service for auxiliaries, but during the past few years there has been a



Endless chain saw for lumber camps

steadily increasing use of the electric motor until many of the largest engineering projects are to-day being carried through almost entirely by means of motor drive. This improvement in condition is the result of the greater familiarity of contractors in general with the characteristics of electric service and by the reliable results obtained by the use of the highly efficient modern electric motor. It is now possible to select motors specially suited to the particular load conditions imposed by any isolated piece of work. Added to the convenience of electric drive it has been shown that the actual cost of the different operations shows a considerable saving over steam use.

For practically all operations necessary in excavation and construction work the electric motor constitutes the most effective medium for the application of power especially when the machinery operated is located at a distance from the

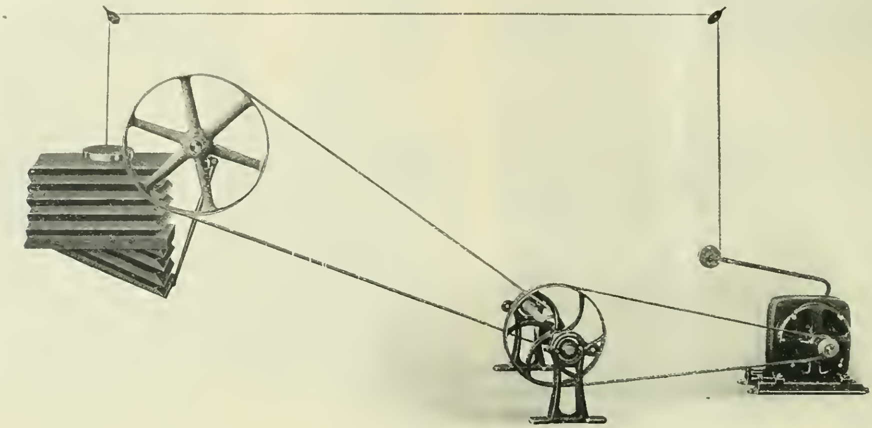


Motor driving log-sawing equipment

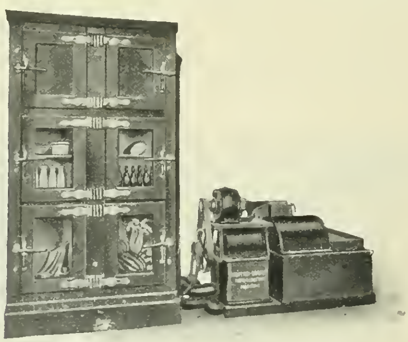
primary source of power. One of the most important characteristics of electric operation in excavation and construction work is the centralization of the power generating plant. By this centralization the cost of supervision and maintenance is greatly reduced. The use of electricity eliminates the necessity for the laying and maintaining of long lines of steam or air piping which are expensive to install and frequently difficult to keep in good condition.

In the application of electric motors to the various ma-

chines, the reliability and simplicity is such that their operation does not necessitate as expensive labor as is required when machinery is operated by steam engines. The number of uses to which motors may be put in this class of work is almost unlimited but a few may be mentioned such as operation of cable cars, excavating shovels, cranes, derricks, hoists, pumps, air compressors, locomotives for various sections of the work, dredges, bridge operation, elevators, crushers, mixers, etc. One of the cuts shown herewith represents the delivering of concrete to electrically operated cableways at Gatun Locks on the Panama Canal. Gatun Locks constitute the largest single piece of concrete construction in connection with this great work, calling for a total of more than 2,000,000 cubic yards. For supplying current for the material handling plants, two substantial power stations each equipped with three 1500 kv.a., 3-phase, 25-cycle, 2200 volt, turbo-generators were provided.



Kimble s. p. motor operating a pipe organ bellows

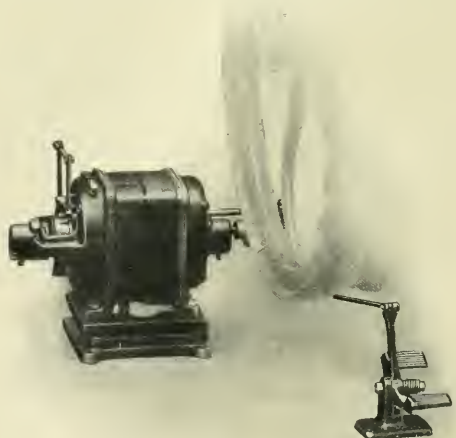


Motor driving J-M household refrigerator

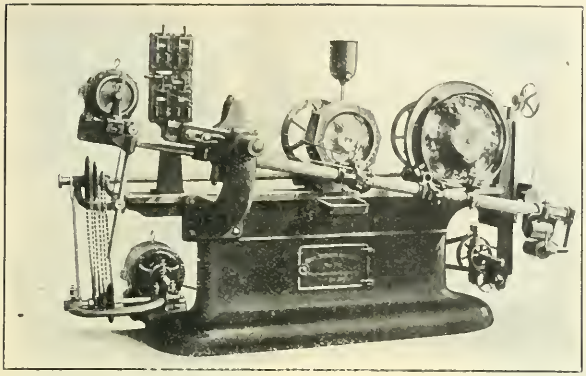
Even in the smallest contracting work, as for example, in house building, the contractor finds it to his advantage nowadays to install a small motor to keep his tools in condition, operate a circular saw, etc.

Farm Appliances

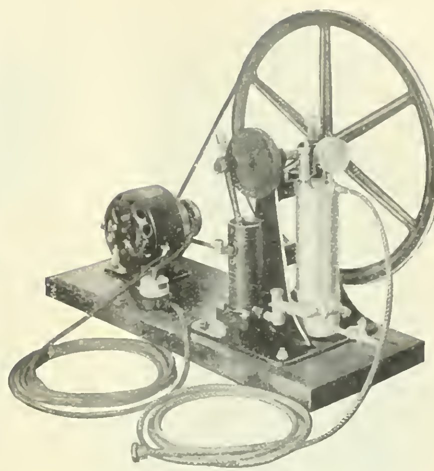
The next few years will undoubtedly see a marked development along electrical lines in this direction. In the past the application of electricity to various phases of farm life has been retarded by the isolation of the farmer. The erection of transmission lines covering rural districts has been more expensive on account of the relatively small load that could be expected to follow. Small isolated plants sufficient for the requirements of any individual farm were sometimes installed but these require considerable mechanical skill for their operation and besides represent a considerable initial cost. The tendency of the present decade however, seems to point to the installation of transmission lines along practically every highway, at least in the immediate vicinity of central stations. The attitude of the farmer too is more favorable towards the utilization of electricity than was the case a few years ago. He has now come to recognize the difficulty of keeping his sons from going to the cities and the still greater difficulty of procuring labor when it is most needed. The use of electricity with its attractiveness will not only be the means of keeping the boys at home, but will also lighten and expedite the labor of the farm to such an extent that this work, which has formerly



Showing foot control of Kimble motor



C.W. motor operating engraving machine



Century motor operating air pump

been considered as one of the most unattractive forms of drudgery, promises in the near future to be looked forward to with pleasure and interest.

It is not likely that in the near future we shall see any general application of electricity to outdoor work, such as ploughing or the driving of farm machinery. The applicability will be through the operation of small motors in the home and around the farm buildings and of course in lighting these. Reports which are more or less conflicting have stated that satisfactory results have been obtained in stimulating the growth of grain or vegetables by the proximity of high tension currents but at this distance the process looks too expensive and uncertain. In the home however, the use of electricity is as applicable as in a city house and on account of the greater need even more so. For example, a water pumping outfit can be fitted up at small expense. Vacuum cleaners, meat choppers, coffee grinders, etc., are applicable. There is no reason why the mistress of the farm household should not have her electric vibrator, her electric hair-drier, her ice cream freezer, her electric fan, her electric polisher, washing machine, ironing machine, churn, sewing machine, and all the other little electrical appliances, just as well as her city sister. With the natural attractiveness of farm life it begins to look as if the movement in the very near future would be reversed and that difficulty will be experienced in keeping the rural sections from becoming overcrowded and the cities from becoming depleted.

Around the buildings too small motors are not only handy, but they are intensely practical. For example, in milking, in grinding grain or pulping vegetables or operating the fanning-mill. A little larger motor equipment may be used to advantage in unloading hay and grain, in threshing, in cutting and storing ensilage, chaff cutting, etc. Doubtless in the near future, storage battery operated motors will also be used extensively in traction work such as hauling in grain from the fields, distributing fertilizer, etc. The application of the small motor will also find an outlet in the operation of cleaning apparatus for the cattle and horses. We believe the average farmer will in the very near future find it to his interest to make a complete installation of the necessary motors for the applications mentioned above, and we believe that the expense both of installation and of operation will work out to be well repaid by the numerous advantages that will follow.

From time to time the Electrical News has described particular instances of the applications of electricity to farms. The most generally adopted method seems to be to give each individual farmer his own transformer. As a general thing this current has not been metered, the recognized moral attitude of the farmer being considered sufficient guarantee that he will keep within the amount for which he makes a contract. We believe central stations are finding this load a very satisfactory one, over-lapping in such a way as to give a quite good load factor. A number of applications of electricity to farm life are shown herewith.

Motor driven auto-horn

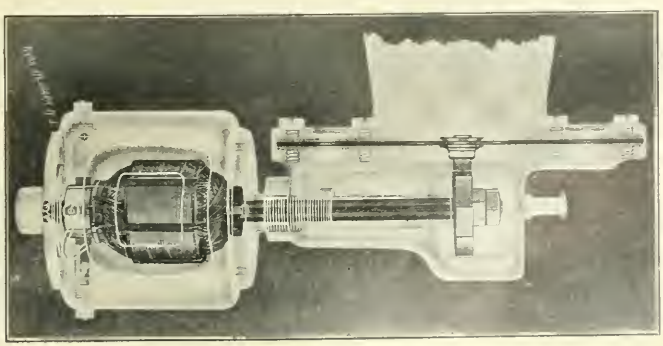
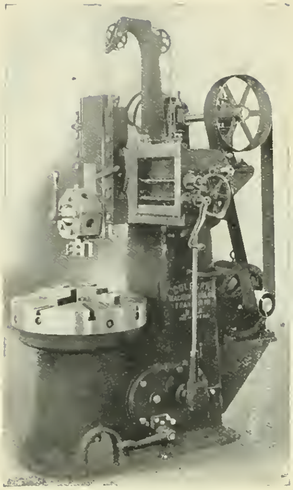
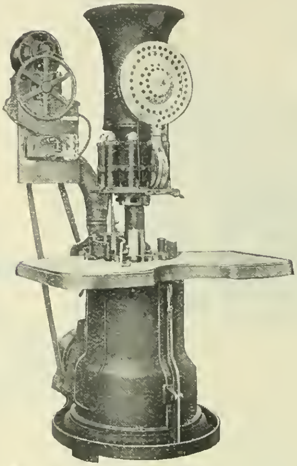


Diagram showing principle of motor driven auto-horn



Motor operating boring mill



C.W. motor operating bottle corker

Century motor driving coffee mill

Gold Dredges

The capacity of the steam driven dredge is largely limited by the scarcity of available fuel and the cost of obtaining it. It has now been recognized that the electric motor affords a compact, easily controlled and highly efficient substitute. Separate motors can be applied either directly or through short belting to the various units of the dredging machinery so that a larger percentage of the input energy can be applied directly in useful work. Among the uses made of motors on gold dredges are for operating buckets, winches, shakers, stackers, high pressure pumps, low pressure pumps, priming pumps, tool machines, etc.

Grain Elevators and Flour Mills

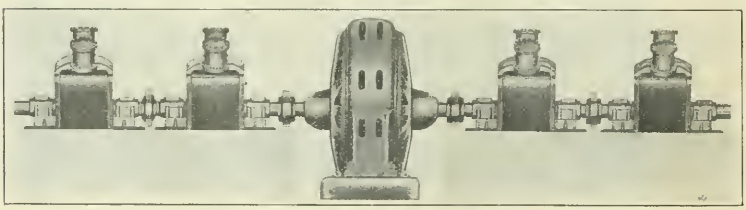
Among the considerations entering into the economic operation of the modern grain elevator and flour mill, perhaps the most important is the type of drive employed for the grain handling and milling machinery as this has a direct bearing on the quantity of product obtained for a given investment and determines largely the percentage of profit which may be obtained from the grain passing through the elevators and mills. In the past it has been the practice to drive the legs and conveyors by means of long lines of shafting or by rope or belt transmission operated by reciprocating steam engines or other prime movers but it has more recently been found that induction motors possess advantages for this work which render them superior to any other type of operative.

While in theory the best method of operating grain handling machinery is to use individual motor drive throughout, the practice in most of the grain elevators and mills which have adopted electric drive, has been to combine the individual and group systems. Ordinarily in grain elevators, individual motors are supplied for each elevator leg, car puller and exhaust fan while the cleaning machinery such as separators, screw conveyors, dust collectors, etc., are generally driven in groups by single motors. In flour mills the several milling processes are inter-dependent and it is therefore necessary that the different sections of the machinery should move as one unit. To accomplish this result with any drive the use of a large amount of shafting and belting is unavoidable with its consequent friction loss but under motor driving conditions the amount of loss is considerably less than under any other condition. Additional advantages are that the motors can be located close to the machinery so as to apply their power centrally on the main shaft also reducing the length of shafting and belting.

Among the further uses to which motors may be put in the modern milling industry is for driving the following:—dust fans, receiving elevators, shipping elevators, cleaner elevators, dryer elevators, car shovels, car pullers, belt conveyors, cleaning machines, passenger elevators, dust packers, dust agitators, etc.

Iron and Steel Industry

In no other industry is absolute continuity of process such an important consideration. The financial loss resulting from the temporary shut down of the main rolls is estimated at from $400 to $1,000 per hour, depending upon the nature



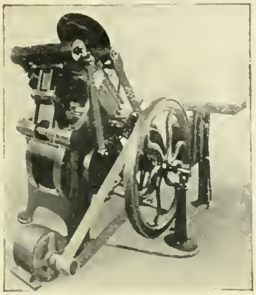
C.G.E. motor driving a number of pulp grinders on the same shaft

Masco massage vibrator

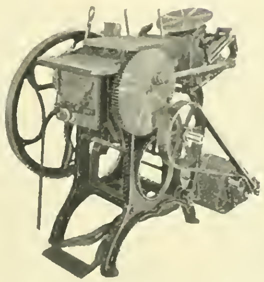
of the work involved. It is thus obvious that 24 hour service is of prime importance and that only the most efficient and dependable drive is permissible. For all steel mill work the electric motor has deserved this enviable reputation.

The practical and economic use of electricity in steel mills is of course by no means confined to power applications. The illumination of large areas consumes a considerable amount of energy and the electric furnace which has apparently passed the experimental stage will, when it establishes itself on a commercial basis require the installation of large additional generating units.

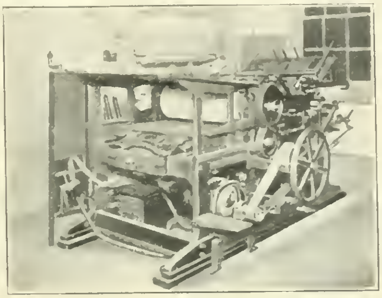
For the most part the motor equipments required in steel manufacturing are of comparatively large size including hoists, mixers, hoisting machines, plate mills, cranes, trucks, charging larrys, coke pushers, for operating furnace doors, hot saws, scale cars, plate shears, angle shears, bar mills, gas exhausters, blowers, hammer mills, coke extractors, unloaders, friction saws, gas washers, etc.



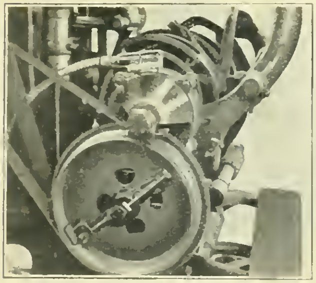
Small printing press, C.W. motor



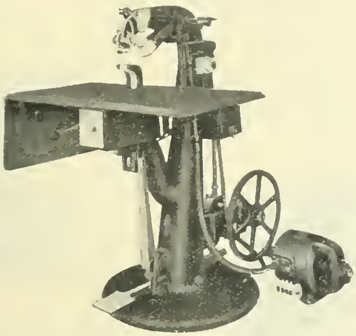
C.G.E. motor driving job press



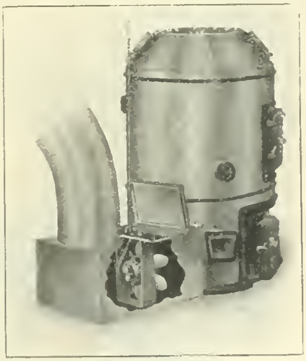
C.G.E. motor driving cylinder press



C.G.E. motor driving linotype machine



Pageing and numbering machine, ½ h.p. C.G.E. motor

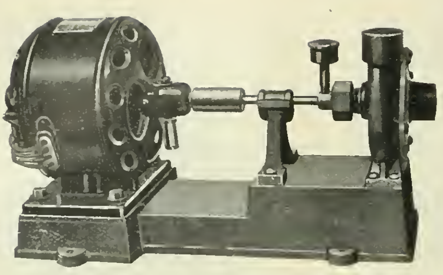


C.G.E motor operating draft fan

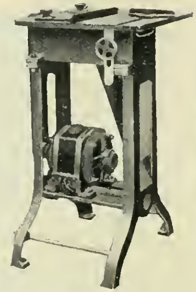
Lumber Industry

As in all manufacturing establishments the ideal attainment in the lumber mill is a maximum output with a minimum investment and a minimum up-keep expense. Electric power in so far as it contributes to this result is being given an ever increasing amount of attention and experience shows that under the severest service conditions electric drive has proven that it possesses advantages of efficiency and economy that are peculiarly associated with the conditions met with in the lumbering industry. It greatly reduces the waste of power in transmission. It improves the quality of the product. It increases the factor of safety to both machinery and workmen. It reduces the fire hazard. It practically eliminates overhead shafting and belts which interfere with proper lighting and ventilation, limit the location of machinery and thus prevent that natural sequence of location which is essential to avoid re-handling with its attendant expense, damage and congestion. An important feature is the ability to operate any group of machines or any individual machine at any time without utilizing the whole power equipment of the plant. The total amount of floor space required is greatly reduced and there is a marked improvement in the general appearance of the plant from the point of view of cleanliness, tidiness, safety and illumination.

In the lumbering industry fairly large sized motors are necessary. Up to the present time there has not been a very extended use of electricity in felling and sawing logs, but we understand developments along this line may be looked for in the near future. We illustrate herewith a couple of motor operated saws for lumbering purposes. The first refers to a product of the International Endless Chain Co., the second is manufactured by Jno. Pickles & Son, an English firm. Rather more progress has been made in logging by electricity especially where conditions are favorable. Motor equipments have also been used for unloading and loading purposes. The first equipment installed for this purpose was purchased barely three years ago, but the application has been pronounced a success. We understand also an electric motor equipment will soon be adapted to the log conveyor. Other uses which may be said to have become established are for driving circular saws of all sizes, blowers, band saws, for automatic filing and for elevated tramways to



Century motor operating small pump



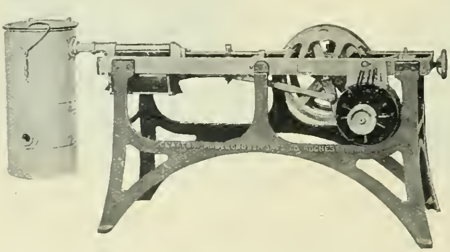
Motor driven metal saw

Masco motor on small pump

yards. Another use to which motors are applicable is in the hauling up of the logs into the mills. The size of these motors will vary of course with the size of the mill, but many of the applications mentioned would not require more than one or two h.p.

Metal Working Machinery

In the metal working industry as in woodworking, the large number of small machines operated for a comparatively short time at considerable intervals make the application of small motors particularly adaptable. Motor drive in the metal working industries has been successfully employed for a number of years and the resultant benefits are so widely appreciated that continued developments may be looked for. While increased production, and of a better quality, is obviously the most important result attained by the installation of electric drive, it is also true that direct economies are very frequently effected in the power costs. Apart from the saving in energy made possible by the ability of the operator to shut down those machines not engaged in productive work, the elimination of shafting, belts, pulleys, idlers, etc., which form an indispensable part of any mechanical system of drive, must, of necessity, result in important power economies, especially when it is remembered that mechanical drives often consume up to four times the energy required by the machines themselves. With individual motor drives the maximum power is made effective at the tool itself.



C.W. motor driving suction cleaner

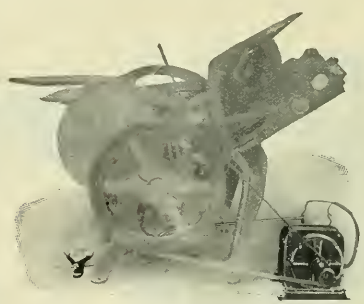
Where individual motors are employed the most convenient and logical location of the machines may be secured, space easily provided for additional machines, use of overhead cranes facilitated, and other requisites to a properly conducted shop made possible.

Among the applications of electric motors in this industry may be mentioned the drill press, the portable drill of various types, cutting saws, cold saws, friction saws, shapers, slotters, lathes, milling machines, surface grinders, chucking machines, boring mills, planers, punch and shears, pipe machines, nipple machines, pumps, wheel presses, etc.

Printing and Allied Trades

It is probably safe to say that no other industrial field requiring motive power has found electric drive more valuable than the printing and allied trades. They have been foremost too in appreciating the ability of motor drive to meet the exacting requirements of the industry. With electric power the printing establishments may be located in the most desirable business section where good light and easily accessible rooms are available. The day is past when printers, cramped in ill-lighted, dingy quarters remote from the line of travel, approached through dark hallways and by dangerous stairs, can carry on a thrifty business.

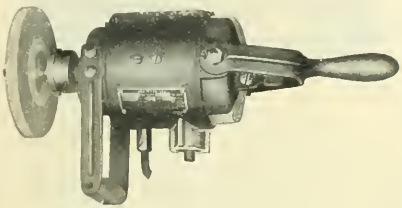
Owing to the great variety of work performed in these trades, the machinery as a rule requires a certain degree of speed variation in order that with a given equipment and force of operators the maximum of high grade production may be turned out. All necessary speed variations are most readily, economically and satisfactorily obtained with electric drive and control. Each press is at all times subject to instant adjustment so that the entire attention of the operator may be devoted to his work. In this connection we draw attention to a couple of the illustrations shown herewith in which the speed of the machinery is regulated by a foot lever. This particular motor is a single-phase reversible type and by its foot control leaves the operator with both hands free. It is claimed by the manufacturers that the operation of this lever becomes in a short time so much a matter of course that the operator regulates the speed of his machine involuntarily and without the slightest interruption to his regular work.



Kimble motor driving printing press

Motor driven presses closely approach ideal conditions for maximum production at minimum expenditure for a number of reasons; make-ready speeds may be instantly and correctly secured; operative speeds may be set and maintained to give the maximum number of perfect impressions obtainable per unit of time; the smoothness of acceleration and steady torque of the electric motor prolong the life of the

press, permit better work and minimize delays often attributable to the driving unit; all individually driven machines being independent of alignment with respect to counter shafting may as a result be arranged to secure every advantage from natural lighting facilities and be so located as to result in the most expeditious and efficient sequence of work; the substitution of electric drive results in a cleaner and more sanitary shop. In addition to the above advantages, it may be added that accident risks are decreased, it is easier to calculate productive costs, enlarged power capacities are al-



Van Dorn & Dutton aerial grinder

most instantly available, all non-productive space can be utilized, over-time work can be handled economically, fire risks are reduced and the insurance rates lowered.

These are but a few of the many advantages following the installation of electric drive in the printing and allied trades. The applications include such machines as presses, linotype machines, monotype machines, bronzers, stitching machines, ruling machines, perforating machines, pageing and numbering machines, folding machines, paper cutters, punching machines, etc., a number of which are illustrated herewith.

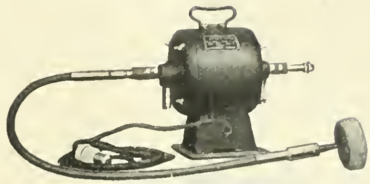
Pulp and Paper Mills

In considering the adoption of electric drive in pulp and paper mills for either a new plant or to supersede mechanical drive in an old one, the management must be assured of uninterrupted service and a definite saving in cost of production either by a low installation expense by increasing the percentage of the power developed which is actually applied to useful work or by a reduction in operating expense. It has been demonstrated in numerous instances that electric drive combines these advantages for some of the following reasons: —The location of the power plant may be selected to permit of greatest economy in generation of power. The cost of installation is less, due to the elimination or at least reduction of the heavy shafting and belting; this in turn allows of lighter structural work. The machinery can be located with a view to the elimination of all unnecessary handling of a product as each machine or group of machines can be supplied with its own motor and operated as an independent unit.

Great economy in power can be obtained where individual motor drive is adopted by the elimination or reduction of the friction losses involved in the operation of shafting, belts, gears, idlers, and other consumers of energy.

The greater part of the power used in a pulp and paper mill is of course, in connection with the grinders, but the following list is representative of the uses to which smaller motors may be put and the requirements in each case.

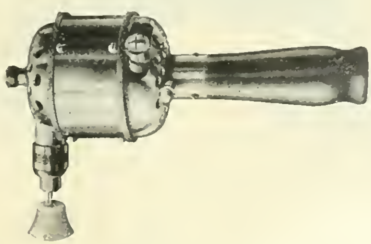
Motor Distribution	No.	H.P.	Drive
8 agitators	1	60	belt
3 Jordans	3	150	direct
2 Jordans	1	250	belt
3 Jordans	1	300	belt
1 Jordan	1	150	belt
2 beaters	1	150	chain
4 beaters	1	250	belt
2 washers	2	75	chain
1 washer	1	40	chain
4 screens and 4 deckers	1	75	belt
Size mixing outfit	1	50	belt
4 paper dusters	1	25	belt
Waste paper baler	1	2	belt
Hydraulic elevator pump	1	50	belt
Pump for agitators and stock tanks	1	30	belt
Stock pump and chest	1	15	belt
Stock pump and chest	1	20	belt
Boiler house pump	1	15	belt
Boiler feed pump	1	30	belt
Water pump	1	30	belt
Water pump	1	75	belt
3 paper machines constant speed end	3	75	chain
3 save-all pumps	3	10	direct
Water pump and air compressor	1	15	belt
Paper winder	1	20	belt
Paper winder	1	7.5	belt
4 super-calenders	4	75	geared
5 super-calenders	5	50	geared
1 super-calender	1	100	geared
Threading-in rolls	10	15	geared
10 paper cutters and 1 trimmer	1	30	belt
Machine shop	1	15	belt



C.W. motor driving polisher and buffer

Refrigerating Machinery

In general there are two methods employed in the manufacture of artificial ice, the first known as the "can" system, which requires distilled water to produce a clear ice free from bubbles, the second the "plate" system in which ice is manufactured from the raw or undistilled water, usually in large plates. Both of these systems require compressors to supply the necessary liquid ammonia for freezing. The application of electric drive to ice making and refrigerating plants have the same advantages over steam as in all other industries. A



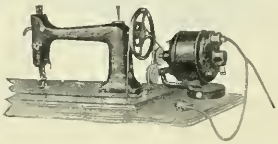
Lindstrom Smith vibrator

low operating cost is assured by the steady character of the load and it is generally recognized that the quality of the product is vastly superior to that turned out by steam driven plants where the product is subject to contamination by oils, grease and dirt.

In addition to the actual manufacture of ice, numerous refrigerating plants are operated by electric motors, the liquid

ammonia or other volatile substance being utilized for cooling a brine for circulating through the compartments to be cooled, by means of coils. The value of motor drive in each of these applications has come to be recognized.

A brief description of the plate system of ice making is of interest. The sheeted ice is formed on an artificially cooled plate used in connection with an ammonia compressor. The liquid ammonia is allowed to evaporate in a system of coils placed between the vertical steel plates which in a typical installation are 15½ ft. long by 9½ ft. wide. A cake of ice of these dimensions and 12 in. thick weighs about 9,400 lbs. A 200 h.p. motor furnishes power to the ammonia compressor which is rope driven from a large pulley located between the two horizontal cylinders. This equipment is rated at 100 tons



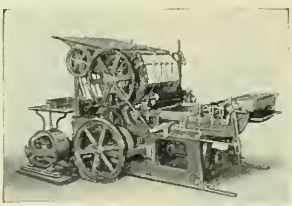
C.W. motor driving sewing machine

of ice per day and it is possible to disconnect one side of the compressor, operating the other side as a single engine and thus increasing the flexibility of the plant.

In order to produce ice free from air bubbles, the water is kept in motion while freezing by the use of compressed air. When the cake is built up to the desired thickness, a hot ammonia gas is sent through the pipe system, thus loosening the cake.

The tanks are arranged in two rows, each served by a 7-ton crane. To facilitate handling two-eye bolts are cast into each cake of ice. Each crane is operated by two induction motors of 5 and 3 h.p. respectively. The ice cakes are lowered to a horizontal position by means of two tilting tables. The operating motor for these tables is a 2 h.p.

The ice is now ready for the motor driven saw which is so arranged that a cut may be made in either of two direc-



C.W. motor operated printing press

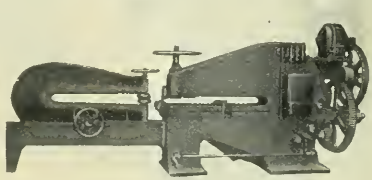
tions at right angles. This saw is operated by a 3 h.p. motor and runs at about 1200 r.p.m.

In addition to the above mentioned motors, small units of from 2 to 7½ h.p. are also used for the operation of water and brine pumps, compressors and ice elevator. One of the cuts shown herewith represents a 20 h.p. direct current motor driving a number of ice cream freezers. Another cut shows a small refrigerating plant for use in private houses or hotels.

Electric Drive in Woodworking Plants

The rapidly increasing use of electric motor drive in woodworking plants is due largely to the success which has been obtained in numerous recent installations. It has been proven beyond question that the electric motor renders the most convenient and economical service obtainable, due largely to the recognition of the value of this industry by the motor manufacturer who has endeavored to meet the particular needs of the woodworking industry by designing motors specially adapted to the operation of machines used in the manufacture of lumber products.

Among the advantages of electric drive in the woodworking industry may be mentioned a saving in the cost of production either by increasing the quantity of the product with a given tool equipment or by a reduction in operating



C.G.E. motor driven circular shears

expenses. It greatly reduces the waste of power in transmission, thereby increasing production for a given power purchase. It improves the factor of safety both to machinery and operatives; it reduces in a marked degree the fire hazard; it practically eliminates overhead shafting and belts which not only distribute dust and interfere with ventilation and lighting but frequently limit the location of machinery; it effects a reduction in the amount of floor space required. An important feature of motor drive is the ability to operate any group of machines or any separate machine over time or at usual hours without putting the whole plant into operation. This greatly reduces the cost of current. The majority of woodworking machines are operated only intermittently. The tools in general complete the cut quickly and a considerable period elapses between the completion of one cut and the beginning of another. This condition not only is the means of saving the cost of current during the off load, but the short duration of the operation enables the motors to work at overload capacity, thus reducing also the original cost of motors. Such a motor drive does not require the heavy shafting and belting inseparable from mechanical drive. The building itself may be of lighter construction as the motors may be installed either on the floor, wall or ceiling and may be connected either by short belts or direct to the drive shaft of the machine.

In the application of electric drive to the modern woodworking plant, two general systems are now in vogue, namely, the operation of each individual machine by its own motor called "individual drive" and the operation of machinery in "groups" by means of line shafting, the shaft

C.W. motor driving ironing machine

being driven by a motor and the individual machines being belted to the shaft. The relative values of group and individual drive must of course be determined in every instance by a careful analysis of the requirements of every installation, and while there are many successful examples of economical group drive it appears to be now the general opinion that in the majority of cases highest efficiency both for the machinery driven and for the motor equipment can be best obtained by the application of a separate motor to each unit.

This is especially true where the operation of the machines is intermittent as in this case current is being consumed only during the actual operation of the machine. Though, as said above, the choice of either group or individual motor drive must depend on local conditions, service, requirements, etc., we give herewith a typical general scheme of individual and group motor drive which would be applicable to the average woodworking plant. The size of motor generally installed for the various machines is also given as well as the method of connection.

Individual Motor Drive

Description	Method of Drive	Size of Motor
Swing Saw	Belted	3 H.P.
42" band rip saw	Direct	10 H.P.
Six-foot glue jointer ..	Direct	5 H.P.
30" roughing planer	Belted	15 H.P.
24" facer	Belted	5 H.P.
36" sander	Direct	10 H.P.
Back shaping machine . .	Direct	15 H.P.
24" planer	Belted	10 H.P.
Arm boring machine .. .	Belted	3 H.P.
Flexible boring machine . .	Belted	1 H.P.
Rubbing machine	Belted	1 H.P.
60" veneer knife	Belted	2 H.P.
Double exhaust fan	Direct	30 H.P.
Two elevators	Belted	7.5 H.P. each
32" band saw	Belted	2 H.P.
Tenoning machine	Direct	3 H.P.
Double cut-off saw	Belted	5 H.P.
Shaper	Direct	3 H.P.
Jointer . . .	Belted	3 H.P.
Edging saw . .	Belted	5 H.P.

Group Drives

3 H.P. Motor—Jig saw, two boring machines.

3 H.P. Motor—Saw gummer, knife grinder.

3 H. P. Motor—Cabinet saw, drill press.

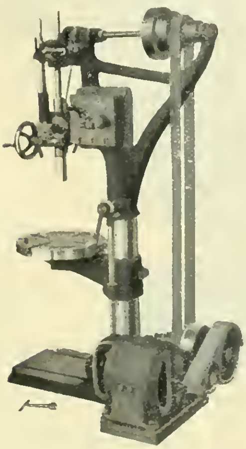
10 H.P. Motor—Disc sander, emery stand, knife grinder, carving machine, cabinet saw.

The Very Small Motor

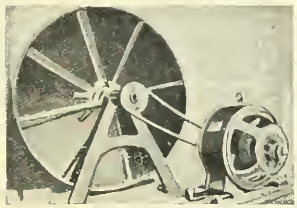
What the steam engine did for the 19th century, the small electric motor is doing for the 20th. Steam did not lessen labor, but shouldered the greater burdens of man like a giant, and similarly, the electric motor is further relieving life of the small drudgeries in home and shop, and in the field, as well as taking its part in the world's greater engineering efforts. If steam is the giant, then the small electric motor may be called the black dwarf, who does things quicker, steadier, more continuously and in tinier places than man could do them.

The range of mechanical operations that can be effected by electric motors is widening daily, and there is scarcely a position or condition for which a motor is not provided.

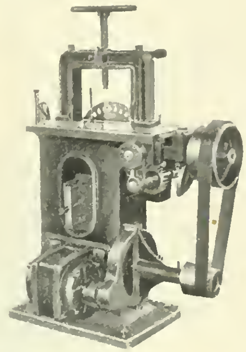
Take the homely task of washing clothes—there is a motor for that, and it does the back breaking work of removing the dirt, while the laundress is wringing and hanging



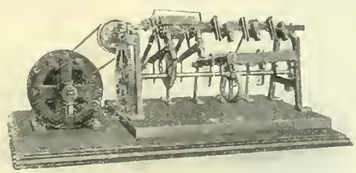
C.G E. motor driving drill press



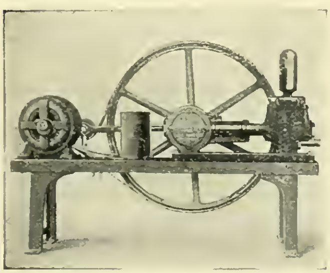
C.W. motor belted to ventilating fan



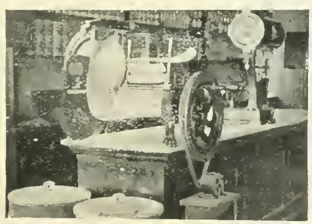
2 h.p. motor driving cold saw



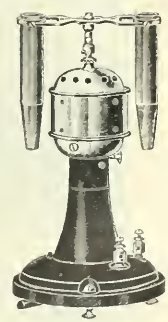
C.W. motor operating sign flasher



C.W. motor operating household pump



C.W. motor driving meat chopper



Lindstrom Smith centrifuge

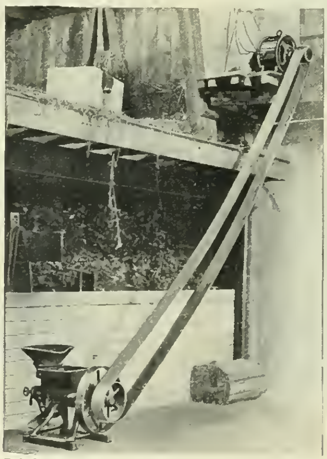
out those already washed—saving her time and strength as well. Such a motor can make itself very useful in a home if given a chance. The owner of one of these 1/8 h.p. motors bought it originally to run his washing machine. It proved such a success that he looked for other uses, and soon had it driving his foot-power lathe. Then he bought a small chuck which fitted the motor shaft and carried emery wheels, buffing and polishing wheels, small circular saws, grinding wheels and other devices, a mere recital of which suggests the possibilities of the small motor as an agency for polishing silver and other metal surfaces, grinding tools and implements, sharpening knives, etc., and doing these much quicker and better than by hand. Turning the ice cream freezer or running the sewing machine, is a mere trifle for the small motor. To a man with a workshop for either amusement or business, it is a decidedly helpful servant: running his lathe and other small tools, requiring power.

In the home, the hotel or restaurant, one of these can be put to work in a variety of ways, such as operating the washer, and wringer, washing dishes or turning the ice cream freezer, running the ironing machine, or maybe operating a small pump or air compressor, revolving the dough mixer, egg beater, meat chopper or coffee-mill, giving life to a dumb waiter, or clearing out foul vapors by a ventilating fan.

In the office, the letter opener, envelope-sealer, duplicating and addressing machines, coin counters, or adding machines, may all be worked by motor.

In the store—revolving window displays, **sign-flashers**, and the nimble cash carrier, depend mostly upon motor power, and the butcher's meat chopper is being harnessed to the same agency.

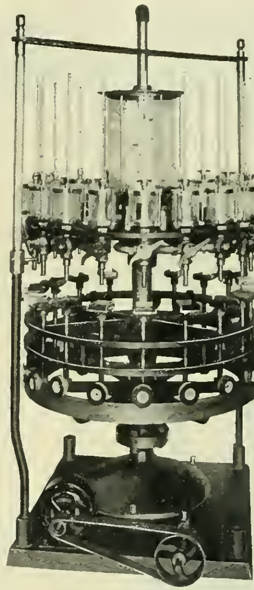
For the Jeweler, Optician, Dentist and Garage Manager the small motor is almost indispensable, the two latter being specially served by the operating of air compressors, or in the use of the flexible shaft,—in the one case for "painless"



C.W. motor operating small farm grinder

drilling and in the other for the cleaning and polishing of the numerous metal surfaces of his "machines." Even the humble peanut may have a better and cheaper roast handed out, and the candy spinner be given more regular gyrations by aid of the small motor than by hand—while the printer and bookbinder in running their typesetters, ruling and routing machines by small motor power can save much time and energy better employed in other operations. In a word, wherever a monotonous, constant, lengthy, turning or other regular motion is required, there the small motor does work more cheaply and better than any hand power can do it. But one of the latest and most novel applications of electric energy is in the direction of farm life: being at once a result of the extension of hydro-electric systems, and a reason for further extension thereof.

Indeed the reign of the electric motor is only beginning, the reasons in its favor are so many: among them, compact-



Century motor driving bottle filler

ness as compared with boiler and engine, sustained energy, easy control, greater safety, quiet and cleanliness, and the fact that they can be placed on walls and hung from ceilings. Then there is low operating cost,—any device requiring the strength of a full-grown man to operate, can be driven all day by one of these motors for a very few cents, and the cost ceases when the motor stops. Another point is, that by using motors instead of steam power you apply only the power needed and only where it is needed, greatly reducing cost of production. These motors may be had from 1-10 h.p. up, in various fractions of a horse-power and on, up to the big motor class.

Supplementary Summary

In order to better emphasize the general applicability of the very small motor the following list of suggestions is appended. This list may be considered as supplementary to the uses that have been already outlined although it is true that in particular instances overlapping will occur. Our idea in reproducing it is, in part, that it may be of assistance to the business solicitor. One or more of the lines of business mentioned in the list is carried on in every city, town and village on this continent and though it will often not be found possible to drive all the machinery in any establishment by motors, there will generally be some single machines which are intermittently required and to which electric drive will appeal, to the owner, as being especially applicable. If the list is helpful it serves our purpose of reproducing it here; if it is incomplete, the reader is at liberty to add to it, and for such omissions we make no apologies.

Addressing—Addressing machines, paper cutters, printing machines.

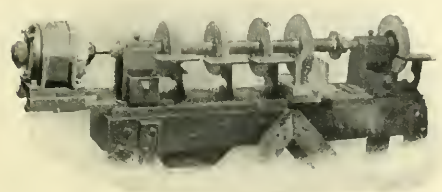
Bicycles—Blowers for brazing, buffs, drills, emery straps, emery wheels, lathes, saws, whips.

Blacksmiths—Drills, fans, forge blowers, helve and trip hammers, lathes, punches, shears, whips or hoists.

Blank Books—Fans, paper cutters, printing presses, ruling machines, smashing press, whips.

Book Binders—Drying fans, embossing presses, freight hoists, paper cutters, smashers, stitchers, ventilating fans, whips.

Bottlers—Bottle cleaners, fans, hoists or whips, pumps, wiring machines.



1 h.p. motor driving Grinding set

Carpenters—Band saws, circular saws, exhaust blowers, grindstones, hoists, jig saws, lathes, molders, planers, ventilating fans.

Clothiers—Cloth cutters, sewing machines, ventilating fans.

Cigar Manufacturers—Branding machines (requiring small motors), ventilating fans.

Coffee Mills—Cleaners, exhaust fans, grinders, roasters, ventilating fans, whip hoists.

Confectioners—Candy pans, chocolate mills, cream stirrers, cutters, exhaust fans, grinders, kiss cutters, mixers, pressers, rolls.

Cutlers—Blowers, buffers, cold saws, drills, exhaust fans, grinders, hoists, punches, shears.

Dentists—Buff wheels, drills, fans, grinders, lathes, saws.

Drugs—Drug mills, fans, grinders, whips.

Dry-Goods Stores—Cash carrier systems, fans, sewing machines, whips and hoists.

Electrotypers—Brush wheels, circular saws, drills, drying fans, electroplating machines, generators, planers, routers, ventilating fans.

Engravers—Drills, routers, saws.

Gas and Steam Fitting—Buffs, fans, lathes, pipe cutters, presses, threading machines, whips or hoists.

Gas Fixtures—Blowers, buffs, fans, hoists, lathes, saws, whips.

Grocers—Coffee mills, fans, hoists or whips.

Harness Shops or Saddlers—Buffs, fans, rollers, sewing machines, skivers.

Hotels—Dish washers, dough mixers, exhaust fans, ice and refrigerating machines, ice cream freezers, knife grinders, laundry machines, meat choppers, pitcher cleaners, ventilating fans.

Jewelers—Blowers, buffs, lap wheels, lathes, ring machines, ventilating fans.

Knit Goods—Braiders, button machines, knitting machines, looms, sewing machines, ventilating fans, whips.

Newspapers—Blowers, fans, form hoists, linotypes, pneumatic tubes, presses, routers, saws.

Opticians—Blowers, drills, exhaust fans, grindstones, lap wheels.

Paper boxes—Automatic box machines, die machines, fans (drying and ventilating) presses, saws, whips.

Paper Dealers—Fans, gumming machines, paper cutters, perforators, ruling machines, whips or hoists.

Printers—Cylinder presses, form elevators, job presses, linotypes, paper and form hoist, paper cutters, ruling machines, stitchers, type bar machines, ventilating fans.

Repair Shops—Fans, forge blowers, sundry machinery, whips.

Restaurants—Coffee grinders, dough mixers, grindstones, ice cream machines, knife cleanser, laundry machinery, meat choppers, pitcher cleaners, ventilating fans.

Saloons and Cafes—Ice cream freezers, ventilating fans.

Shoemakers—Buttonhole machines, edgers, Goodyear machinery, McKay machinery, rollers, sewing machines, skivers.

Shirtwaist and Dressmakers—Cloth cutters, fans, sewing machines.

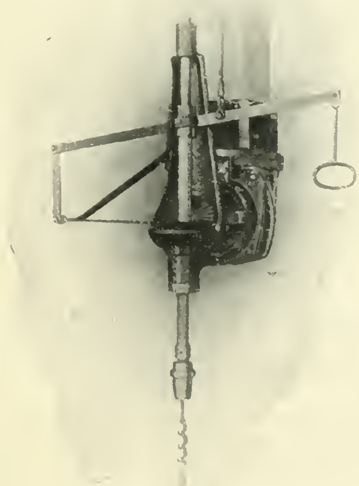
Silversmiths—Blowers, buffs, drills, fans, lathes.

Stationers—Fans, paper cutters, perforators, printing presses, ruling machines, whips or hoists.

Tailors—Cloth cutters, fans, sewing machines.

Tin and Brassware—Blowers, buffs, drop press, fans, grinders, presses, punches, straighteners for wire and plate.

Tobacconists—Cleaners, cutters, fans—exhaust and ventilating, hoists and whips, presses, shredders.



2 h.p. C.G.E. motor driving wood borer

Umbrellas and Canes—Buffs, lathes, presses, saws, sewing machines.

Public Buildings—Ventilation, air purification, water circulation, hoists, forced drafts, pneumatic tubes.

Medical Purposes—Vibrators, centrifugal machines.

Music Stores—Music boxes, player pianos.

Modistes—Vibrators, polishers, hair dryers.

Barbers—Head massage, hair dryers.

The government telephone line in the interior of B. C. is to be extended to Chase and the district near Shuswap Lake.

The sixth regular meeting of the Toronto section of the A.I.E.E., was held on April 25th, 1913. The meeting was addressed by Mr. E. E. F. Creighton, of the General Electric Company, Schnectady, on the subject of "Electrical Protection."

ELECTRIC RAILWAYS

Wreckless vs. Reckless Railroading

A movement has recently been organized by the Canadian Pacific Railway Company with the object of emphasizing the value of caution in every phase of railroad work. The movement has been named the "Safety First" movement and is said to have been adopted by over forty prominent railway systems in the United States covering some 150,000 miles of line. We reproduce herewith sections of a paper recently read by Mr. N. S. Dunlop, claims adjuster of the Eastern Section of the C. P. R., before the Canadian Railway Club, and although this paper was prepared specially with steam roads in mind there is so much community of interests between steam roads and electric roads that the ideas expressed by Mr. Dunlop are almost equally applicable to the latter. This movement is apparently, and we believe justly, meeting with wonderful popularity among the employees and patrons of all the roads adopting it and we think its application may well be extended, not only to our electric roads but to practically every form of industrial activity of the present day. In the discussion which followed the greatest enthusiasm was expressed by everyone who had made a study or had noticed the results of this form of missionary work. Mr. R. M. Hannaford of the Montreal Tramways Company expressed himself as being of the opinion that this paper was of vital importance to all electric railways as well as steam railways, and stated that they were making a special campaign on behalf of the "Safety First" idea and were issuing blotters and reading matter to the public and asking their co-operation.

"Safety First"

The claims adjusters of all the railways in America, who have to follow the investigation of every accident to employees and the public, and finally settle the claims arising therefrom, are credited with originating the "Safety First" plan among railway employees.

They had a strong feeling that if the large number of avoidable accidents and serious injuries to employees were pointed out to them, they would immediately see the necessity for adopting "Safety First" measures for their own personal safety.

According to the report of the United States Interstate Commerce Commission, and the report of the Railway Commission for Canada, for 1911, there were 3,865 employees killed and 130,158 injured—more than 10 employees killed and 3,562 injured every day in the year. A man killed, or injured, about every 24 seconds.

Now, who is paying this appalling toll? Not the public, not the officers, not the clerks. The men who are paying this toll are the men on the firing line in every department of operation, and a close investigation and observation, extending over many years, has shown that from 60 to 90 per cent. of these accidents are preventable, and occur through men taking chances.

Every time a serious accident happens, the doctor, the nurse, the minister, and the priest are called to the home, and injuries mean suffering, sorrow and expense. Every time you take an experienced man out of the service, you put an inexperienced man in the service, somewhere, and you not only increase the accident risk to men in the service, but you lessen the efficiency of the whole organization.

The Canadian Pacific Railway adopted the "Safety First" scheme more than a year ago with good results. Fourty-four prominent railways in the United States and Canada have adopted the plan covering 144,329 miles of railway.

In each district committees are formed with a chairman and secretary, and members from every department of operation serve on these committees and hold meetings regularly. The committees are composed of superintendents, agents, engineers, firemen, conductors, trainmen, yardmen, trackmen, freight porters, checkers, roadmasters, sectionmen, etc., etc. Every department has a right to be represented, and every employee of the railway is expected to be a "Safety First" man.

Most of the railways have adopted a "Safety First" button, worn by the committee men, and in many cases employees are asking that they be supplied with buttons, to demonstrate their interest in the subject, by wearing them at all times.

If the committee meetings are held during working hours, the committee men are allowed their time and their expenses, if they are away from home.

Any employee interested in the "Safety First" movement who sees anything which might lead to the loss of life, or injury to a fellow employee, either corrects that defect at once himself, if he is able to do so, or reports it to a member of the "Safety First" committee for discussion and immediate action. Anything which can be corrected by the superintendent, or other officer in charge of the department, is attended to at once, and if the matter involves considerable expense, or changes in plans and policy, it is reported to the general, or central committee, for discussion with the management.

Literature is distributed among the employees calling upon them to be careful at all times and not to take chances.

"Safety First" means a wise selection of men and educating them to believe that "Safety First" is simply a habit. Men are taught to think first and act afterwards. They are educated to look out for unsafe conditions. They are enjoined to do the safe thing always, and to remember that it is better to let a train wait than to cause an accident.

The investigation of accidents shows that it is the little thing which many people do not bother about that leads up to a serious accident.

"Safety First" says emphatically "do not take chances." The time between the prevention of an accident and causing one is only a matter of a few seconds.

The careless, indifferent foreman will have careless men under him, and a greater number of accidents than the man who is always alive to "Safety First."

The conductor's highest duty is the protection of his passengers and he should exercise great care in the starting and stopping of his train, and live up to the very spirit and letter of the rule book.

All men engaged in the operation of trains should at all times observe the strictest sobriety, have proper rest, know the rule book by heart, and observe without any quibbling, every rule in the book. They should have no family troubles, and while on duty think of nothing else but duty.

If in doubt, stop. It is better to delay your train than land yourself and your passengers in eternity.

Men should tell their fellow employees of the dangers of their work before an accident happens, and warn them how to avoid it.

Never approve the actions of careless men. Caution them for their own good and for the good of others.

The vast importance of "Safety First" is demonstrated in the words themselves. You may write volumes on these two words, analyze them describe their objects, explain them any

way you like, but you cannot add to the emphasis of that slogan which is bound to reach more railway men, and be of vastly more importance, than any subject they have ever taken up.

On a large number of railways special men have been appointed whose duties are solely to educate the men on "Safety First" habits. This is done by printed literature, lectures, moving pictures showing the right and wrong way of doing work, correcting defective conditions and impressing upon the minds of all classes of employees the danger of taking chances.

In the operation of a railway "Safety First" should be placed above everything else. Unless men are willing to be careful and avoid injury to themselves and their fellow workmen, they should not engage in railway work. A railway does not want careless men in its employ "Safety First" is always a great convenience, but in an emergency it is an absolute necessity.

The "Safety First" habit must be the creed of every railway man who hopes to succeed in the prevention of preventable accidents.

Do not allow telephone or telegraph wires to hang too low over tracks. Cut them before some poor fellow is knocked off the top of a car and paralyzed for life.

Whenever an employee is killed, or injured, sorrow, suffering, expense, and, if he lives, crippled earning power, is the result.

Do not allow a man with one eye to work where cars are being moved. He cannot see from the blind side.

"Safety First" never sleeps. It says: "Report and have corrected as soon as possible anything which would cause an accident." It calls at all times for suggestions and ideas, from employees, how to save men's lives and limbs.

"Safety First" is not started with a view to fault finding, or tattling on employees. Every employee is a member of "Safety First," and when he realizes that he cannot evade some responsibility, directly or indirectly, whenever a fellow employee's life is sacrificed, or an injury comes to him, he will report to his committee, or superior officer, anything which he sees might cause an accident to an employee, or the public.

The chance taker is a widow maker and an orphan maker.

Do not scoff at "Safety First." It is pounding an anvil chorus on your ear drums to-night, craving and begging for your interest and support in a movement which should have the consideration of every railway man, every man engaged in industrial pursuits, no matter in what department he is employed.

The "Safety First" habit is spreading. Get the "Safety First" habit. Practice it on every occasion, in matters little as well as momentous, until it becomes second nature, automatic, like the air brake, so that a departure from the safe course would jar your conscience into wakefulness and arouse conscience.

It takes less time to prevent an accident than it does to write a report explaining how it happened.

Greater safety means greater efficiency in operation. There is real dignity in "Safety First." It displays character, manliness, education and energy.

Many accidents are not inevitable. The great majority of them are preventable and can be avoided with care.

The most important factor in the operation of railways for all time to come will be men.

"Safety First" teaches them not to take chances, not to sell their lives and limbs cheaply and foolishly by taking chances.

Victoria to Deep Cove

Announcement was recently made by the management of the British Columbia Electric Railway Company that on May 15th the interurban line from Victoria to Deep Cove will be placed in operation.

This line extends from the city of Victoria, Vancouver Island, for a distance of 23 miles to the north. It passes through the centre of the Saanich Peninsula which is an arm of land at the southeastern corner of the Island with the Gulf of Georgia on one side and the Saanich Inlet on the other. The district is capable of great development as an agricultural centre and also provides admirable facilities for the location of suburban homes. The Victoria press unite in stating that the opening of the district by the interurban line will do more to advance the growth of the country surrounding Victoria than could be done in any other way.

The line will be the second longest interurban line operated by the B. C. Electric, the longest division of the company's system being that from Vancouver to Chilliwack, a distance of 76 miles.

The B. C. Electric controls several large holdings along the route of the new line and these will be developed as model townsites. It is also probable as the district develops, that a good freight business will originate along the line, milk, produce, etc., being brought from the agricultural sections to supply the needs of Victoria. Plans are already being made for the location of industries along the line and two large cement plants are already located at points which will be tapped by the route.

The rolling stock which has been allotted to the line consists of 4 passenger cars, 2 baggage and express cars, 1 45-ton locomotive and 25 box cars. It is proposed to inaugurate the service by the operation of 2 train cars, with 3 train cars being used as the business develops. Locations have been allotted for about 20 stations along the line, located about a mile apart, Shuttle structures of the usual interurban type will be provided at each of these points.

The Burnaby Franchise

The Burnaby Municipal Council is submitting to the electors a tram franchise by-law in favor of the British Columbia Electric Railway Company, April 26th, being the day set for a poll on the measure. The by-law provides that the company shall construct extensions of its lines on Hastings street, east from Vancouver and an extension of its New Westminster city lines along the North Road. The term of the franchise will be about 36 years, the general terms of the agreement being similar to the franchise agreement under which the company now operates its system in the municipalities of South Vancouver and Point Grey.

The British Columbia Electric Railway was granted a 40-year franchise in Burnaby by the Municipal Council in 1909. With the passage of this measure the company constructed a line passing through Burnaby and connecting Vancouver with New Westminster, this line being now in operation. In 1911 a question was raised as to the validity of the company's franchise in Burnaby because of the fact that the agreement was not ratified by the electors. The question was taken into the British Columbia courts and last year Mr. Justice Murphy rendered a decision stating that the franchise was valid. Notice of an appeal from the decision of the B. C. court to the Privy Council has been given by the municipality. In the meantime negotiations were carried on which have resulted in the forming of the franchise upon which the Burnaby electors will vote on April 26th. The passage of the measure will naturally result in the municipality abandoning its appeal to the Privy Council. Should the measure be defeated, the company will press before the

Privy Council for a decision that its franchise granted in 1909 is valid.

The municipality of Burnaby is now developing very rapidly and the district touches both Vancouver and New Westminster, and suburban settlement for these cities is steadily advancing from either boundary. The terms of the tram agreement now proposed by the B. C. Electric will do much to assist in the development of the district.

B.C.E.R. Extensions

Announcement has been made by the B. C. Electric Railway as to certain tram extensions which will be made in the territory covered by the company during the present year.

In Victoria the company propose to construct a line from Pandora avenue along Quadra street to Bay street and thence easterly to Shelbourne street, the route serving the suburban section of the city which is now rapidly developing.

In South Vancouver the company proposes to lay an extension of its track on Westminster road nearly a mile in length, provision being made for further extending the line along Westminster road to the limits of the municipality in the future. This track will be a permanent type and will be laid in connection with permanent pavement which will be constructed this year.

Another extension to the company's line in South Vancouver which is planned for 1913, is a line connecting the South Vancouver lines with the city line terminating at Cedar Cottage, a point located in the extreme southeastern part of Vancouver. This line will run from Westminster road to Cedar Cottage and will be nearly a mile in length.

Rolling Stock for 1913

The additional rolling stock which will be demanded for the lines of the B. C. Electric Railway during 1913 will represent an expenditure of over $750,000.

The principal item of the Company's 1913 budget for rolling stock consists of 65 passenger cars, an order for which was placed with the Preston Car & Coach Company during the latter part of last year, delivery of which is to be made during the coming summer. In addition to these cars there will be demanded for city service 16 passenger cars. Over its interurban lines the company will require three additional passenger coaches, 3 baggage and express cars and 2 combination mail cars, the latter probably being constructed in the company's shops from equipment now on hand.

For freight service of the company the demands call for 50 box cars, 30 flat cars and 25 steel dump cars. The company's plans also call for the purchase of 3 snow sweepers.

During the month the company has received 2 50-ton locomotives from the Westinghouse Company, Pittsburg, this equipment having been ordered last year. The locomotives are of the latest type and will be used on the Fraser Valley division of the company's lines.

Fender Stood the Test

Early in April an interesting test of a new automatic street car fender took place at Vancouver before several B. C. Electric Railway officials, and the officers of the United States company owning the patent. Previous tests of this fender, which was first used on the Portland, Oregon, street railway system, proved that the device works either on contact with a person or can be controlled by the motorman from the car cab. Compressed air supplied by the same compressor that compresses air for the air brakes is used to operate it. Among the features claimed for this fender are: that it can be folded back against the car when it is necessary to couple two cars, that it is very quick in action, ano operates under any circumstances.

For the tests at Vancouver two dummies were used, one wooden, which was the first used. It was placed on the track in a sitting position and the car run toward it at a fair rate of speed. The dummy was lifted right off the pavement, and kept entirely clear of the wheels or other moving parts of the car. The same dummy was then put in a standing position; the same result was apparent. In the first test the fender was allowed to work automatically, and in the second instance the fender was lowered by the motorman.

The stuffed dummy was then brought into place and put in several positions on the track; all the tests were successful. Mr. F. A. Nelson, inventor of the device, was present at the trial.

Montreal Car Service

All reports and suggestions for improving the Montreal car service have been placed in the hands of Mr. G. Janin, the city engineer, and Mr. McLeod, assistant engineer. Mr. Robert, the president of the Tramways company, has also been in conference with the Board of Control, at which the former made certain suggestions for relieving the congestion, and promised later to submit plans providing for future development. Rolling stock is to be increased as fast as possible, the tracks are to be repaved, and certain lines relaid.

Reduced Lighting Rates

On April 1st the B. C. Electric Railway Company granted a reduction in the private lighting rates for Hastings townsite and D. L. 301, two districts adjacent to Vancouver. These sections were recently annexed to the city but a regular suburban lighting rate has prevailed in the territory until this time. The new rates place the districts on the same basis as the Vancouver city rate. The old rates ranged from 15 cents per kw. hour for the first 50 hours to 8 cents per kw. hour for over 2,000 hours. A monthly meter rental of 25 cents being charged. The new rates are 11 cents per kw. hour for the first 50 hours ranging down to 4 cents per kw. hour on consumption over 2,000 hours, with a monthly meter rental of 15 cents. About 1,300 customers are affected by the change.

Enlarging the Aqueduct

Tenders have been invited by the Montreal City Council for the widening of the aqueduct from Point St. Charles to Lachine, a distance of six miles, at an estimated cost of $2,000,000. The city have already spent this sum on the conduit alongside the aqueduct and the preliminary widening, which in its present condition will supply 6,000 horse-power, to be used for pumping. The new work to be undertaken will enable an additional 4,000 horse-power to be generated, and this will be utilized for the lighting of the city. No plans for the electrical equipment have yet been made, but the intention is to replace the present steam plant, and to use it as a reserve. The width of the aqueduct will be about 174 feet on the water line, and 145 feet at the bottom. Concrete retaining walls will be constructed the entire way. The excavated channel will be about 16 feet deep.

The Electric Railway Equipment Company announce that owing to increased business, they have been compelled to secure larger quarters for their eastern office, and that after May 1st, it will be located at 30 Church street, Hudson Terminal Building, New York City. Mr. J. G. Kipp will remain in charge. It is stated that since the opening of their eastern office this company have been doing a very gratifying business, as they are now in a much better position to handle export trade.

Illumination

Luminous Arc Lamps

The long burning luminous arc or magnetite arc lamp is becoming so popular on account of its efficiency and its adaptability, especially for street lighting, that we present herewith a description of the mechanism of the lamp with a few comments on its characteristics.

The name Luminous Arc arises from the fact that the light is produced from the incandescence of the arc itself instead of the incandescence of one of the electrodes, as was the case largely with the old carbon type of street arc lamps. The positive electrode of the magnetite arc is pure copper. The negative electrode is made of a mixture of oxides of different metals of which magnetite, an oxide of iron, is the one which gives to the electrode its properties of conductivity and long life. The arc issuing from this compound electrode is intensely brilliant and blueish white in color, and is surrounded by a concentric envelope of solid particles which appear on close inspection as a yellowish luminous flame.

This lower, negative electrode is in appearance an iron tube filled with a heavy black powdery mineral substance. As stated above, iron in the form of the oxide is relied upon chiefly as the carrier of the current. The oxide used is known as magnetite and has the formulae FeO, Fe_2O_3, which

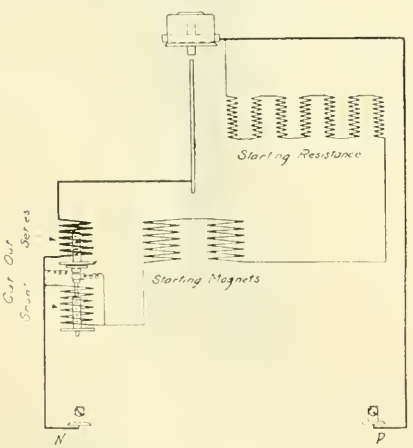


Fig. 1. Connections of Luminous arc lamps.

has a metallic content of over 72 per cent. As magnetite gives off, itself, a comparatively small amount of light, it was necessary to mix with it a light-giving substance, and search was made for the one in which the same amount of energy produces more light in the arc than any other substance known. The particular substance which has been found, with magnetite, to increase the luminosity of the arc to the greatest extent is a dioxide of titanium known popularly as rutile and having a formulae TiO_2. The titanium is sometimes introduced chemically, combined with the iron in which case more even operation of the arc results. It has further been found that by the introduction of chromium, the life of the electrode is greatly increased. Chromium also is generally introduced in the form of an oxide though a mineral called chromite which is a double oxide of chromium and iron and has the formulae FeO, Cr_2O_3 has been found most satisfactory. These minerals after being prepared in great purity, are carefully crushed between hardened steel rolls. After their passing through a screen of great fineness, the mixture is passed under the poles of a mag-

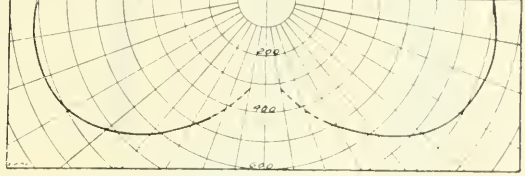


Fig. 2. Curve showing light distribution.

netic separator to lift any magnetite or other magnetic impurities.

The process of filling the iron tubes with a mixture of iron, chromium and titanium oxides is called loading. In this process electrically welded iron tubes with tightly fitting steel thimbles at the lower ends are packed into a machine which is so constructed and operated that a moving element is slowly lifted several inches and then dropped upon the heavy base of the apparatus. During the loading of a standard luminous electrode about 3,000 impulses are delivered by the loading apparatus during which time the luminous mixture is slowly and evenly delivered to the filling machine. After the electrodes are loaded they are thoroughly dried in a steam heated oven at a temperature of 150 deg. C. for 24 hours. The upper end of the electrode is then closed with a moisture proof and dust proof seal and covered with a thin disc of sheet iron to insure perfect contact with the upper electrode when the lamp is first started. They are then given the protecting coating of oil to keep the sheath from rust.

When operating at standard adjustments (6.6 amp. at 75 to 80 volts across the arc) the life of the lower, or magnetite, electrode is from 150 to 175 hours and that of the upper or copper electrode from 3,000 to 4,000 hours.

The wiring connections of a series luminous arc lamp of the inverted type is shown in Fig. 1, from which the cycle of operation may be understood. The current enters the

terminal P. passes through the starting resistance, starting magnets and the cut-out contacts to the negative terminal N. The starting coils are those energized and the lower electrode is brought into contact with the positive establishing the arc, and the circuit, through the series cut-out coil. This coil, on becoming energized, separates the contacts and opens the circuit through the starting coils thus allowing the lower electrode to fall back to its normal posi-

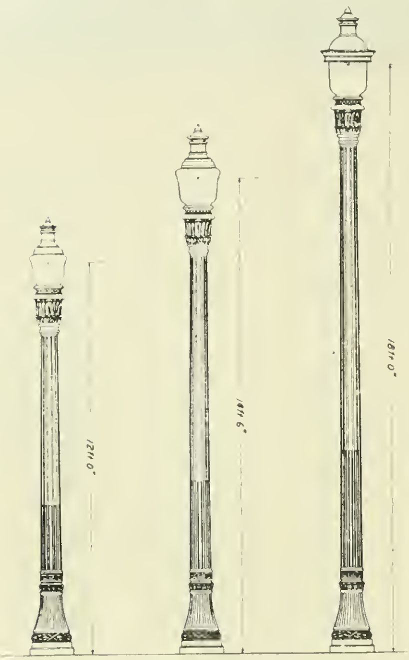


Fig. 3. Three types of luminous arc units.

tion, retarded by the dash-pots. The electrodes remain in this position until for some reason the voltage at the arc momentarily reaches a point sufficiently high to actuate the shunt magnet, when the contracts are once more closed and the cycle of operation is repeated. The standard magnetite electrode measures 9-16 in. in diameter by 15 in. in length.

As already stated this lamp has now been adapted admirably for ornamental street lighting. The distribution of light is unusually good, the greatest intensity occurring from 10 to 30 deg. below the horizontal plane of the lamp, thereby giving a very uniform illumination over a maximum of street area. At the same time sufficient light is given above the horizontal plane to illuminate adjacent buildings in all their detail. The photometric curve shown in Fig. 2 illustrates the excellent distribution obtained.

In the ornamental type of lamp the trimming operation is simple as the removal of the globe is unnecessary. Only one electrode requires renewal. To accomplish this, the chimney is raised and swung to one side, leaving the lower electrode exposed. After trimming, the chimney is simply raised and swung back into its position.

This lamp has now been standardized in three forms of ornamental luminous arc lighting units (1) known as the Great White Way lamp, in two forms, consuming 520 watts at 6.6 amp. and 320 watts at 4 amp.; (2) the residential lamp consuming 300 watts at 4 amp., and (3) the Parkway lamp designed for operation at both 4 and 6.6 amps., consuming 300 and 500 watts respectively. These three types of lamp are exemplified in Fig. 3.

As these lamps operate only on direct-current, it is necessary in towns and cities where alternating current only is distributed that some sort of rectifying apparatus be installed. A motor-generator is often used but owing to the fact that the mercury arc rectifier possesses many advantages, including higher efficiency, this type of apparatus is coming into very general use. The life of the mercury arc rectifier varies greatly though a life of over 7,000 hours has been obtained.

Unique and Handsome Fixture

A lighting fixture of particularly unique and handsome appearance is shown herewith. A pair of these has recently been installed by Mr. Warren Y. Soper, of Ottawa, at the entrance to the grounds of his private residence "Lorando," Rockcliffe Park. Mr. Soper recently returned from a trip abroad and while in Italy he espied this unique design, the product of a famous Italian artist of the 16th century, the

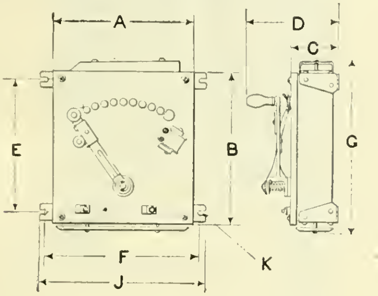
Fixture of handsome antique design.

original of which is still to be seen in the Strozzi Palace of Florence. The beauty of the design so impressed Ottawa's electrical magnate that he returned to his native city with a model of the original from which he has had two reproductions made and placed as indicated above. The construction work was taken in hand by the Ottawa Car Company, who have reason, with Mr. Soper, to be proud of the artistic result. Fortunately the lamps will not be equipped with candle dips or any similar illuminant of the middle ages, but give out real day-light by the liberal use of the modern tungsten lamp. The electrolier as shown, stands approximately 9 feet in height.

The Dealer and Contractor

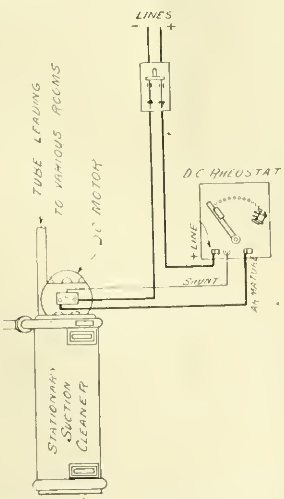
Control of Stationary Suction Cleaners.

The growing use for suction cleaners of the stationary type has created a demand for a variety of control which the electrical contractor sometimes finds himself at a loss to supply on the spur of the moment. Some of the machines are started by hand operated rheostats but the majority use self starters capable of control from one or more points located advantageously throughout the building to be served.



Dimension diagram of rheostat.

Beginning with the present issue, we propose to reproduce a number of diagrams showing the wiring arrangements necessary. The present reproductions refer to the most elementary installation possible, a direct current equipment using hand starting rheostat. A simple diagram of the rheostat is shown in dimension for horse powers from 1 to 50 and voltages from 115 to 500. Under these conditions A varies from 8 in. to 16 in., B from 9 in. to 18 in., C from 2⅞ in. to 12¼ in., D from 5⅞ in. to 18¾ in., E from 7⅞ in. to 20⅛ in., F from 8⅞ in. to 19 in., G from 8⅝ in. to 22½ in., J from 9½ in. to 20 in., K from ¼ to 7-16 in. These dimensions have reference to controllers manufactured by the Cutler-Hammer Company, specially for the Tuec suction cleaner.



Wiring diagram of simple installation.

The wiring diagram shown herewith represents the simplest form of electrical installation for the operation of a stationary motor. In this case it will be seen that the motor can only be started and stopped at the controller. While this arrangement possesses the advantage of simplicity and low first cost, these may easily be offset by increased operating costs due to carelessness in having the motor running longer than is necessary.

New Benjamin Button Surface Switch.

The accompanying cut illustrates a new type C-H surface switch recently put on the market by the Benjamin Electric Manufacturing Company of Canada, Limited, who manufacture all Cutler-Hammer wiring devices in the Dominion. This new round base switch, used with concealed or open wiring, has been designed because of the demand for a small surface switch of good appearance. The small and ingenious C-H mechanism permits of operation by means of a single


Button surface switch.

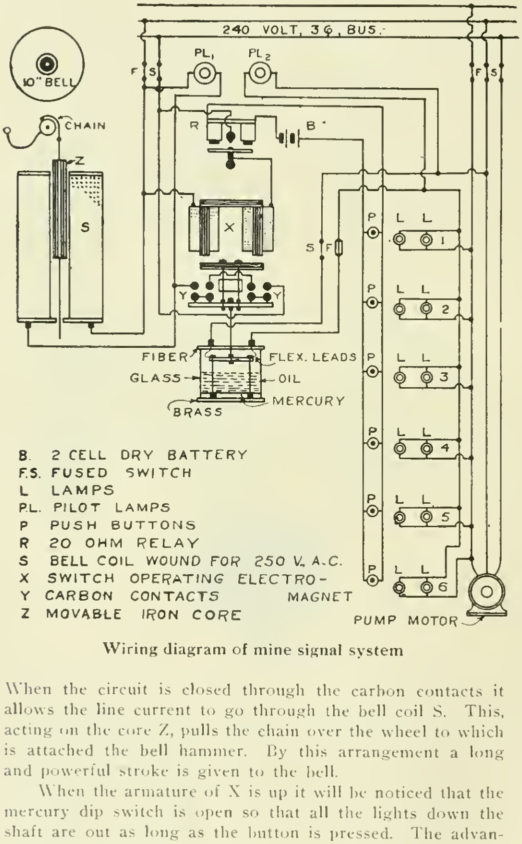
piece push button bar which is part of the mechanism. There is no protruding key to lose or break off. The push bar operates in a straight line and no twisting or turning is necessary. The button of the ordinary snap switch is often turned the wrong way by those not familiar with electric switches or by those mischievously inclined. This is not possible with C-H push button switches. The buttons do not protrude from the front of the cap. The switches may be furnished either with plain face or with label holder for labeling circuits and lamps controlled. The diameter of the switch is only 1¾ in. and the overall depth 1⅝ in. the extra ¾ in. taken up by the usual operating button extending from the cap is eliminated.

Messrs. Waugh, Mesner & Bailey, of Vancouver, have completed the installation of 219 ornamental light standards on Main street, Granville street south, Hastings street east, and Harris street, Vancouver. The standards are exactly similar to those already in use in other parts of the city, and are equipped with five 100-watt tungsten lamps, wired in multiple at 110 volts on 3-wire system.

Electric Mine Signal System.

The accompanying sketch represents the wiring diagram of an electric mine signal system devised by Mr. Elvin F. Brough, of Sulphide, Ont. The system was placed in operation over two years ago and is giving entire satisfaction.

Reference to the sketch will show that by pressing the button on any one of the different levels it closes the circuit from the battery B through the standard 20 ohm telegraph relay R. This in turn closes the line from the 240 volt bus through the switch operating electro-magnet K which is an iron core built up of stove pipe iron to 1 in. square and wound with 1,500 turns of No. 22 S.C.C. wire. This attracts the armature to which are attached four of the carbon contacts Y and also the plunger of the mercury dip switch.



Wiring diagram of mine signal system

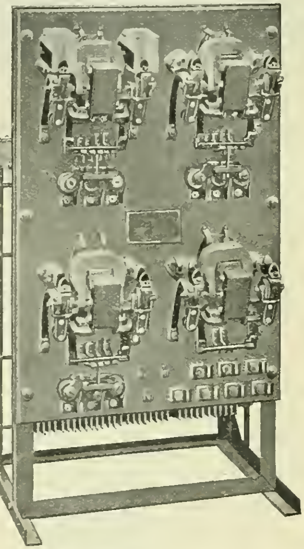
When the circuit is closed through the carbon contacts it allows the line current to go through the bell coil S. This, acting on the core Z, pulls the chain over the wheel to which is attached the bell hammer. By this arrangement a long and powerful stroke is given to the bell.

When the armature of X is up it will be noticed that the mercury dip switch is open so that all the lights down the shaft are out as long as the button is pressed. The advantage of this is easily seen as the signals given from any one level can be read at every other.

The pilot lamps P_1 and P_2 are connected up so that P_1 lights and P_2 goes out when the bell rings.

Self-Starters for Alternating Current Motors.

Automatic or self-starting equipment is particularly advantageous for motors driving reciprocating pumps, air compressors and other machines that must be started under full load and which require a starting torque equal to or in excess of the normal full load torque of the motor. By the use of the new type of polyphase motor self-starters made by the Cutler-Hammer Manufacturing Company, Milwaukee, and shown in the accompanying illustration, the motor can be safely accelerated in the shortest time consistent with a predetermined starting current. The acceleration is controlled by resistance in each phase of the rotor circuit and balanced on all steps which is cut out of circuit by magnetic switches. The closing of these switches depends upon the action of three-phase current relays in the rotor circuit, which allow successive steps of resistance but cut out only



C-H polyphase motor self-starter.

after the current has dropped to a safe value and the motor properly accelerated.

These self-starters are of the multiple solenoid type entirely self-contained, made in standard capacities up to 200 h.p. The primary switch and magnetic starting switches are of the open construction, clapper type. The plungers of the current relays are controlled directly by the starting current and the rate at which the motor is accelerated can be adjusted by varying the spring tension on the relay plungers. The secondary starting resistance is of the cast metal grid type having ample capacity for starting the motor intermittently under load conditions. Where used in connection with motors operating on compression or open tank systems, the motors can be started and stopped automatically by means of pressure regulation or float switches. A parallel line of controllers has also been standardized for use with motors driving centrifugal pumps and machines of similar load characteristics.

New Companies

Letters patent have been issued to the Canada Sign System (Electric) Limited. One of the purposes is stated to be "to acquire, undertake or take over the whole or any part of the business, property and liabilities of the Holman Electric Sign Company."

The Rock Lakes Water & Power Company, Limited, has been incorporated with head office in the town of Fort George, B.C.

The Mirror Lake Electric Light Company, Limited, has been incorporated, the head office of the company being situated at Mirror Lake, B.C.

Flooring for Industrial Plants.

The modern industrial establishment, with its complex machinery, elaborate factory systems and skilled operatives, offers a noteworthy example of evolution from crude and inefficient methods. Not only have mechanical devices been developed to a high state of perfection in the past few decades in order to keep pace with competition, but changes of equal importance have been wrought in the construction of factory buildings, with the object of contributing to the safety, comfort and efficiency of the operatives. Among those details which have received the attention of experts is the subject of flooring.

The problem of flooring the factory is a difficult one, but the obstacles which present themselves in the average plant are claimed to have been overcome by a flooring material known as J-M Mastic, manufactured by the H. W. Johns-Manville Company and described by them as follows. J-M Mastic flooring provides a surface that is water proof and at the same time practically wear-proof under ordinary service condition. It is also unaffected by acids, alkali and brine. Being waterproof it is absolutely sanitary, as it can be quickly and thoroughly cleaned by the simple process of flushing after which it dries out immediately. It will not originate dust, a point of vital importance in establishments where it is imperative to keep machinery and goods free from dust. The base of this flooring is asphalt mastic, a product in which a finely graded mineral aggregate is bonded together by an asphaltic cement or binder. The mineral aggregate in the material, as made up, will pass through a wire screen ranging from 80 to 200 mesh in fineness.

This flooring can be made in any consistency between extreme hardness and softness and, while always dense, possesses a certain amount of resiliency. It does not cause footsoreness and fatigue like concrete and other non-yielding floor surfaces, and adds greatly to the efficiency as well as to the comfort of employees in machine shops, factories and other industries, who are compelled to stand while at work. Furthermore, being damp-proof, it is an efficient protection against ailments common to damp conditions. It can be laid over any foundation which is firm and stable, and may be applied over wood, brick, concrete or tile already in place. In new construction, concrete or heavy mill construction is the most desirable. This flooring is also easily repaired if changes in the floor surface are made necessary at any time. It adds very little to the dead load, as the standard thickness of 1½ inches weighs only 18 lbs. to the square foot in place. This thickness is sufficient for ordinary trucking requirements but can be varied to meet conditions, ranging from 1-inch for lavatories where the requirements are very light, to 3 inches in thickness for loading docks where the requirements are correspondingly severe.

J-M Mastic flooring is perfectly adapted for breweries, canning factories, candy factories, cold storage plants, dairies, dye houses, laboratories, machine shops, packing plants, railroad stations, school houses, institutions, etc. In fact, its scope is almost without limit. It is superior to wood, concrete, brick, tile, slate or composition floors, and may be substituted for floors of those materials to excellent advantage.

Standardizing Their Fittings.

The H. T. Paiste Company have recently made some important changes in their pipe taplet line so as to further standardize these economical conduit fittings. In order to minimize the amount of stock required by dealers, through greater interchangeability of material, certain changes have been made in the sizes of wiring openings so that now 3 sizes of pipe taplet covers are all that are required for sizes of pipe taplets. That is to say the first size of fittings and covers fits all ½ in. and ¾ in. pipe taplets; the second size fits all 1 in. and 1¼ in. pipe taplets, and the third size all 1½ in. and 2 in. pipe taplets; this means that the stock of necessary covers and fittings may be practically reduced by half. These changes do not affect in any way the size and design of the opening in the ½ in. and ¾ in. sizes and these still fit the standard fielding receptacles and rosettes which have been used for years in wooden molding wiring. With this combination of ½ in. and ¾ in. pipe taplets and fieldings the most flexible and economical forms of either lamp or cord outlets are secured.

Bell Ringing Transformer

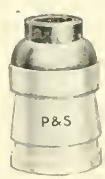
The Thordarson Electric Manufacturing Company, Chicago, have constantly sought to improve their electrical specialties, which is nowhere better exemplified than in their latest model New Junior bell ringer. This is a superior, low-priced, highly-efficient bell ringer, suitable for residence door bells, buzzers and all classes of light signal work. The new model has the same output and capacity as the previous

Junior bell ringer, but it is much smaller and neater in appearance and lower in cost.

The initial investment is the only expense attached to the installation of a bell ringing transformer. It will last indefinitely. The Junior type consumes less than one watt, and for this reason, it is claimed, will not register on the ordinary wattmeter. The manufacturers claim for this bell ringing transformer that it will do more work than any battery and do it better. It may be used for residences, apartment buildings, hotels, office buildings, stores or factories where alternating current is employed.

The P. & S. Keyless Socket.

We illustrate herewith the Pass & Seymour keyless socket embodying the interchangeable feature, the shade holder grooving permitting its use with shade holders. The



socket is complete with ⅜ in. aluminium cap. This is a socket which will stand a lot of hard wear, and exposure to fumes and gases.

Northern Electric Dinner.

The second annual general department dinner of the Northern Electric & Manufacturing Company was held on Saturday evening, April 5, in St. Lawrence Hall, Montreal. Nearly 200 employees of the company were present. Mr. A. M. Ritchie, chief of the production department, was chairman, and at the head table were Mr. P. F. Sise, managing director of the company, Mr. N. E. Newton, shop superintendent, Mr. M. K. Pike, distributing department manager, Mr. E. H. McLea, chief engineer, Mr. H. D. Browne, general purchasing agent, Mr. F. D. Donnelly, installation superintendent, Mr. J. S. Cameron, factory engineer, and Mr. W. H. Davidson, general foreman. The toast to the company was

proposed by Mr. Ritchie and responded to by Mr. Sise, who outlined the remarkable growth of the company's business between the years 1902 and 1913. Mr. Sise expressed himself as greatly pleased at the good fellowship and co-operation evident at this gathering and expressed the hope that the event would remain an annual one. Other speakers included Mr. Pike, Mr. Newton and Mr. McLea.

Steinberger Wins Again

An appeal from an award of priority in the patent office interference case regarding the invention of a disc strain insulator between Louis Steinberger and Edward M. Hewlett, formerly decided in favor of Steinberger, has resulted in a confirmation of the original finding. The recent decision was handed down April 7th, by the Court of Appeal of the District of Columbia, the former decision being confirmed in all points.

The Royal Rotary

A suction cleaner built on the turbine principle, is described in a little booklet issued by Jno. White, St. John, N.B., who manufactures the Royal cleaners. The working and wearing parts of The Royal consist simply of the motor with turbine attached. The motor is of ⅛ h.p. Robbins & Myers type. The cleaner is equipped with a sight glass for observing the workings of the machine.

A new Standard price list on "Sterling" new code rubber-covered wire has been issued by the Standard Underground Cable Company of Canada, Limited, Hamilton, Ont. The price list is in convenient and durable booklet form printed in two colors and gives prices on their "Sterling" wire for bases ranging from 13 to 20 cents for solid and stranded wire of all commercial sizes. Appended are explanatory notes and a list of electric wires and cables and cable accessories manufactured by this company.

The rejuvenation of the Sons of Jove proposed to be held in Montreal on April 19th has been postponed. The degree team had their first rehearsal on the 15th of April, the team being composed as follows: R. H. Balfour, Jupiter; R. J. Hiller, Neptune; A. Dwight Smith, Vulcan; T. R. Campbell, Pluto; W. D. Black, Mars; C. Duncan, Mercury; F. J. Parsons, Apollo; F. W. King, Hercules; C. M. Tate, Avrenim; Imps, Messrs. J. E. Ryan, G. G. McDonald, T. H. Brennan, J. A. Crowhurst; Sergeant-at-arms, D. H. Ross.

The club of the Montreal Jovians at Cooper's Restaurant will have two classes of membership—resident and non-resident. For the former the fee will be $5 until June and $10 afterwards; for non-residents $5 will be charged. The entire flat at the top of the restaurant is now being prepared, and the club promises to be very comfortable. There will be a large dining and lounge room, and in addition to the usual accommodation, a room in which committee meetings or private dinners can be held. The Executive Committee have made an offer to the Montreal Electrical Society for the latter to make the club their headquarters for meetings, the idea being to concentrate the electrical interests of the city.

Trade Publications.

Scaife Tanks—The W. B. Scaife & Sons Company Pittsburgh, have just issued their new catalogue of gasoline storage outfits, gasoline tanks, garage tanks, pumps, etc. These outfits and tanks are suitable not only for gasoline but for oils and other liquids. The catalogue illustrates a number of simple methods of installing these tanks so that they may be well out of the way.

Pneumatic Tools—Bulletins 137, 138 and 139, describing Chicago Giant Rock Drill and appurtenances. Issued by the Chicago Pneumatic Tool Company.

Mazda Lamps—Bulletin 11A issued by the Engineering Department of the National Electric Light Association, descriptive of Mazda 60 candle power street series lamps.

Steel Unilets—The Appleton Electric Company of Chicago have issued a neat booklet in which is fully described and listed the complete line of rectangular steel unilets manufactured by this company.

High Tension Switches—Bulletin No. 5 issued by the Delta-Star Electric Company of 617 West Jackson Blvd., Chicago, descriptive of their high tension type M.B. pole-top switches for controlling loaded circuits.

Frantz Premier—An electric suction cleaner by this name is described in a little booklet just issued by the Premier Vacuum Cleaner Company of Cleveland. This firm is represented in Canada by Messrs. Calvert & Dwyer, 117 Wellington street west, Toronto.

High Tension Switches—Bulletin No. 5 (copyrighted) issued by the Delta-Star Electric Company, Chicago, is an interesting treatise of high tension switching problems and will be of value to managers selling power from high tension lines. Complete information is given as to the installation of switches on poles, insulation tests, etc., and operating characteristics.

Ventilating Fans—Bulletin No. 151 issued by the Mechanical Appliance Company, Milwaukee, describing Watson motor driven ventilating fans made in sizes from 18 in. to 42 in., for d c. and a.c. current, single or polyphase. Methods of installation are illustrated and a chart is included for determining the fan capacity required for rooms of various sizes and used for various purposes as moving picture theatres garages, billiard parlors, restaurants, schools, etc.

Automatic Controllers—The Cutler-Hammer Manufacturing Company of Milwaukee have issued Bulletins 9630, 9632, 9640 and 9642, illustrating and describing a new line of automatic controllers for use with slip-ring polyphase motors operating on low and high voltage circuits. New types of magnetic switches are used on these controllers the construction and functions of which are fully described. Bulletins 6090, 6095, 6100 and 6105 describe types of automatic starters for direct current motors, which are used in place of hand starters where it is desired to get proper acceleration regardless of the carelessness of the workman and where convenience of control is essential. These starters can be placed out of the way and the motor started by merely pressing a button or closing a small switch.

New Books

Wiring diagrams of electrical apparatus and installations—The McGraw-Hill Book Company, New York, publishers. Price, $2 net. This volume contains a collection of circuit diagrams representing, more or less completely, all branches of electrical engineering with the exception of telephony and telegraphy. The diagrams have been taken from actual practice and although some are not new, they all represent important principles. The diagrams show much more than simply wiring connections and by their use it will be possible to lay out a modern switchboard to connect up the apparatus and to understand the principles of operation of the various electrical machines. Armature winding is omitted as requiring too much space for proper treatment. This book contains much that will be of interest and value to the engineer, the operator and the repair man.

Current News and Notes

Barrie, Ont.

On April 14, the arrival of Hydro-electric power from the Severn River was celebrated by a banquet. The rates to be charged will be 4c per hundred square feet of floor space, plus 1½c per kw. hour metered. The commercial lighting rate will be 9c per kw. hour for the first 30 hours use of the installed capacity and 4½c per kw.h. for all additional current. The power rates will be 3.6c per kw.h. for the first 50 hours, 2.4c for the second 50 hours and 1.3 for additional. All rates are subject to a 10 per cent. discount. Barrie has contracted for 750 h.p. but present indications are that this amount will be exceeded during the first year's operations. Barrie has been a believer in municipal control of the electrical plant for the last fifteen years, at which time Dr. S. M. Wells, then mayor of the town, was chiefly instrumental in removing the plant from the control of private interests.

Brandon, Man.

Following an address by Utilities Commissioner Robson before the members of the city council and other interested citizens, a resolution was passed favoring the bringing of the municipal operations of the city under the provisions of the Public Utilities Act. It is at the option of the various municipalities whether they come under this act or not, but Commissioner Robson's work in unifying and standardizing a system of operation for Public Utilities has been so successful that the western towns are showing willingness to avail themselves of the opportunity offered by the government.

Breslau, Ont.

This village has made a request for 100 h.p. to be supplied from the Berlin sub-station. Arrangements are being made for the supply which will also reach Elmira.

Calgary, Alta.

The Northern Electric & Manufacturing Company have been awarded the contract for the installation of a police signal system.

Chicoutimi, P.Q.

La Compagnie des Eaux et de l'Electricite de Chicoutimi, are installing a 1,500 kw. Westinghouse 60 cycle, 3-phase, 2200 volt generator, two 300 kw. 2200/575 volt motor-generators and a 125 kw. exciter. These machines are to replace a 200 kw. 2-phase, 133 cycle unit, a 200 kw. 2-phase, 60 cycle unit and a 200 kw., 575 volt d.c. unit. The new generating equipment will go into service about the first of June. Mr. H. R. Kimball is resident engineer on the construction work.

Dryden, Ont.

A by-law is being submitted authorizing the issue of debentures to the amount of $6,000 to purchase the electric light distribution system of the Dryden Timber & Power Company. Power for operating this system will still be purchased from this company.

Fernie, B.C.

On April 4, a by-law was carried to raise the sum of $10,000 for the purpose of extending the electric light system.

Fort William, Ont.

Four new cars have been shipped by the Ottawa Car Company, and orders have been placed for a number more for summer delivery.

The report of the Water, Light & Telephone Department for the year 1912 recently issued by Mr. A. L. Farquharson, Manager of Utilities, shows that both the light and telephone departments have been operated this year at a profit. The telephone net surplus for the year is $4,025 as against a deficit for the previous year of $2,728. In the lighting department the net surplus for the past year is $21,085, which also is an increase over the surplus of last year of some $8,000. The Waterworks Department shows a loss of $12,928 on the year's operations.

Gananoque, Ont.

It is said the Gananoque Electric Light Company contemplate a transmission line to connect this line and Kingston.

At a recent meeting of the council it was unanimously decided to accept the offer of the Gananoque Electric Light Company for the supply of electric energy and to sign a contract for ten years.

Granby, P.Q.

It is reported that at the next meeting of the provincial legislature the C. P. R. company will apply for a charter to build an electric railway line connecting Farnham with Granby.

Halifax, N.S.

An offer has been received by the city to lease the Halifax Electric Tramway System for a term of years in the event of this road being taken over by the city.

The railway committee of the legislature having recommended that the public ownership bill of the city council be thrown out, the city council are said to have decided to oppose every bill that may be brought forward by Mr. Robert and his associates.

The Halifax Electric Tramway Company, who are planning to develop a water power on the Gaspereaux River, offer, if the city accept their proposition and drop the municipal ownership agitation, to reduce the cost of power and light to an appreciable extent. The price for light is to be reduced from 15 to 10c per kw.h. with liberal discounts. The price of power will be 5c per kw.h. instead of 10c as at present, this offer also carrying liberal discounts. The company in presenting their case figure that their offer means a saving of $76,000 per year to the people of Halifax.

Iroquois Falls, Ont.

It is said to be the intention of the Abitibi Pulp & Paper Mill Company to build a line between here and Kettle Falls to transmit power for their own use, as well as for the town of Cochrane, any mills along the line and the Elexe Nickel Mine at Iroquois Falls.

Kingston, Ont.

It is said that tenders are to be called for conduits to be laid in about seven blocks so that all wires can be placed underground.

Langham, Sask.

A by-law was recently passed to expend $12,000 on the installation of a lighting plant. The British Canadian Engineering & Supply Company have been awarded the contract and the equipment will consist of a Ruston suction gas engine and producer plant coupled to a suitable generator.

Lawrencetown, N.S.

The ratepayers have carried a by-law in favor of installation of a small electric light plant. A 40 h.p. dynamo will be operated by a steam engine now in the town mill. Poles, wire, dynamo, etc., required.

Linden, N.S.

It is reported that an electric plant will be installed at

this point in the near future. The interests reported to be behind the proposition have coal mines in the district, which will enable them to operate the plant at a comparatively low cost.

Montreal, Que.

During the present month 1,000 men will be engaged on the addition to the power plant of the Laurentide Company, Grand'Mere, P.Q. During the winter great progress was made with work on the cofferdams, and when the plant is installed next year about 70,000 horse power will be available, much of which will be sold.

An issue of 5 per cent. first mortgage bonds will be made by the Montreal Public Service Corporation.

The Montreal Tramways Company will install at their William street power house a 1500 kw. motor generator set manufactured by the Canadian Westinghouse Company. The power line will be furnished by the Canadian Light & Power Company.

On retiring from the position of chief electrical inspector of the Canadian Fire Underwriters' Association, Montreal, Mr. James Bennett was presented with a diamond watch charm. The presentation was made by Mr. C. M. Tate, who has succeeded Mr. Bennett, on behalf of the staff in Montreal, Quebec and Sherbrooke. The charm is engraved "31-3-13.—A token of esteem from the staff to Mr. J. Bennett, chief electrical inspector—C.F.U.A." Mr. Bennett made a suitable reply, expressing appreciation of the gift.

The Quebec Railway, Light & Power Company have made a cut from 15c to 7c per kw.h. for private lighting, and the Dorchester Electric Company announce their intention of cutting the price to 6c.

The Quebec Public Utilities Commission have held a further enquiry into electrical conditions in the city of Quebec, at which the Canadian Fire Underwriters' Association were represented by Mr. James Bennett. After a brief hearing the Quebec Railway, Light and Power and the Dorchester Electric Companies were ordered to ground all the transformer secondaries or neutrals on their system. As Mr. Bennett recommended that the grounding be made to the water piping system of the city, the commission instructed the companies to approach the Quebec City Council and endeavor to secure permission to comply with this recommendation, and to report back to the commission the result of their negotiations at a special meeting to be held on the 29th of April at Quebec.

Marysville, N.B.

A movement is under way to secure a street lighting system.

Norwich, Ont.

Mr. H. Webster, owner and formerly manager of the electric light plant, is now offering his equipment for sale, including a 65 h.p. steam engine, transformer equipment, meters, real estate, etc.

Ottawa, Ont.

Action is being renewed to have the overhead telegraph, telephone and light and power wires put underground on the main streets.

Owen Sound, Ont.

The Hydro-electric Power Commission of Ontario have quoted this town a rate of $31 per h.p. for 800 h.p. It is stated that this rate is considered by the citizens as very favorable and likely to be accepted.

Penticton, B.C.

On Thursday, April 3, before a representative gathering of citizens, the new electric light system at Penticton was successfully put in operation. The plant consists of a 200-horse power Diesel oil engine driving a 100-kilowatt dynamo, and it is calculated to supply sufficient power to fill the requirements of the municipality for two years, when it is contemplated to install another unit of equal capacity, provision for which has been made in the new power house.

Pembroke, Ont.

The Town Council contemplate a fire alarm system.

Port Arthur, Ont.

Tenders have been called for a wireless telegraph station, $5,000.

It is reported that the C. N. R. Co. will install a power plant at Lake Helen, near Nipigon, the material being already on the way.

At the end of the present year the joint commission system of operating the Port Arthur and Fort William electric railway will be discontinued and each city will, after that date, operate its own line.

Portsmouth, Ont.

The new street lights were turned on for the first time on April 15th. The system used for turning the lights on and off is that of a time clock.

Peterborough, Ont.

The local legislature have granted the city the right to buy out or expropriate the plant of the Peterborough Light & Power Company. The question as to whether this company has the right to continue in the lighting business as a competitor of the municipality has not yet been determined, and will probably be a matter for the courts to decide.

Regina, Sask.

At a recent discussion of the cheap power question with reference to the use of coal fields in the vicinity, it was stated that power could be produced at 1.53c per kw. hour and a rate of $21.65 could be given manufacturers using more than 100 h.p. It was stated that the consumption of power in Regina had increased from 1,200,000 kw. hours in 1909 to 3,750,000 kw. hours in 1912. The consumption of Moose Jaw, through which the line connecting the mines with Regina would run, was 2,500,000 kw. hours in 1912.

Sackville, N.B.

An electric plant to cost $70,000 is being discussed.

Saskatoon, Sask.

Tenders were received by City Commissioners till April 24 for double tracking certain streets.

The total receipts for the month of March of the Saskatoon Street Railway system were $14,682, an increase of $4,177 over the previous month. This is sufficient to take care of the total expenses for the month and leave a margin of $270. The gross income from the light and power departments for the month of March was $33,080.

Sebringville, Ont.

Lighting and general equipment is to be purchased for the new extension to Sebringville.

Sherbrooke, Que.

The Sherbrooke Railway & Power Company has just completed a new contract for 500 h.p. to be delivered to a new industry about to start operations in Sherbrooke.

Silverton, B.C.

Recent advices from Silverton, B.C., state that several of the leading citizens are negotiating with the New Denver Electric Light Company for the construction of a power line to Silverton and the supply of electric current for lighting purposes throughout the district.

St. Catharines, Ont.

The city council has received an offer from the Lincoln Light & Power Company to supply private consumers at a

rate of 5.6c per kw. hour with 10 per cent. discount. They also agree to abolish meter rates and to reduce the monthly minimum charge to 75c.

Strassburg, Sask.

A by-law was passed on April 14, authorizing an expenditure of $12,000 to cover the cost of an electric light system.

Toronto, Ont.

The Hon. Adam Beck has introduced a bill which will compel all contracts between a municipality and private companies to be submitted to a vote of the ratepayers. This places these contracts on the same footing as contracts with the Hydro-electric Power Commission.

A bill has been introduced in the Provincial House, giving the city of Toronto power to purchase the Toronto street railway and the Toronto Electric Light Company's system. The price mentioned is 160 for the Toronto Railway stock and 135 for the T. E. L. stock, in addition to assuming the bonds in each case.

A bill has been introduced by the Hon. Adam Beck, providing for a network of electric railways through the province of Ontario. Such roads may be constructed by the municipalities themselves, or the work may be undertaken by the Hydro-electric Power Commission. The cost of the railways must be borne by the municipalities concerned. Wherever possible the railways would be built along the right-of-way of the provincial transmission lines.

Following the removal of Mr. W. R. Sweany, acting general manager of the Toronto Hydro-electric system, from office, the Commission has announced the appointment of Mr. Couzens as general manager. Mr. Couzens was, until recently, general manager and electrical engineer of the Corporation of Hempstead, London, Eng., and is said to have had wide experience in both engineering and managerial work. In the interval the operation of the system is being looked after by Mr. R. A. Ross, the consulting engineer of the commission, and Mr. R. G. Black, for many years electrical engineer of the Toronto Electric Light Co.

Direct telegraph communication was recently established between London, Eng., and Victoria, B.C., through the application of a valuable invention of Mr. John Gott, chief electrician of the Mackay Companies.

The Toronto & York Radial Railway Company and the city of Toronto have at last come to an agreement whereby the company agrees to double track its line on Yonge street between Woodlawn avenue and the northern city limits, a distance of approximately four miles. The railway company is also allowed to equip and maintain the extensions and branches between and to connect the present Toronto terminals of the Scarboro, Metropolitan and Mimico divisions. The company is also given the right to operate Sunday cars on the Metropolitan division and to increase their bond issue per mile from $20,000 to $30,000.

Work has begun on the Danforth avenue civic car lines.

In the provincial estimates recently brought down by the government, $2,500,000 is set aside for extensions to the Hydro-electric Power Commission's system. This will include a $150,000 office building.

Plans have been filed by the Toronto and Suburban Railway Company for the entrance of their Woodbridge line into the city, the plans covering the six miles between Davenport Station and Weston.

The Ontario Railway & Municipal Board has made an order fixing the sum the city must pay to the Toronto & York Radial Railway Company in taking over the Humber section of the Mimico line. The amount named is $79,245.

The Electrical Maintenance & Repairs Company, 162 Adelaide street west, Toronto, announce that owing to the large increase in their business they have recently found it necessary to double their factory and office space and have also added the latest facilities for handling heavy work.

The Masco Company, Limited, formerly of 205 Yonge street, Toronto, have moved to more commodious quarters at 58 and 60 Church street.

Valleyfield, Que.

Fire engine and alarm system will be purchased, it is said.

Vancouver, B.C.

Another record was established by the British Columbia Electric Railway Company at Victoria during the first three months of the present year, when the passengers carried on the city and suburban lines of the company aggregated in number 3,099,098, compared with 2,429,659 for the corresponding period in 1912; an increase of 28 per cent.

The Mirror Lake Electric Light Company of Mirror Lake, B.C., recently made application to the provincial authorities for a license to take and use 100 miners' inches of water out of Bjerkness Creek, which empties into Kootenay Lake near Mirror Lake. The water will be diverted about 1,500 feet from the mouth of the creek above the falls, and will be used for power and light purposes in the adjacent district.

The Canadian Pacific Railway Company will excavate a tunnel through the Selkirk Mountains at the point now known as the Rogers Pass. The tunnel will be 5.2 miles in length and at one point is 540 feet below the surface. It is practically certain that electric drive will be installed through the tunnel. Later advices also state that the C. P. R. have decided upon a second tunnel through the famous Kicking Horse Pass of the Rockies. This tunnel will be sixteen miles long, the longest in the world. The eastern end of the tunnel would be in Alberta and the western end in British Columbia. Doubtless also this tunnel will be electrified.

Wallaceburg, Ont.

The Premier Electric Light & Power Company, Limited, W. R. Waghorne, manager, who are at present operating a 133 cycle, single phase, 120 kw. steam generator, contemplate changing over to gas engine power and generating 3-phase, 60 cycles.

Windsor, Ont.

By an overwhelming vote the citizens of Detroit on April 7, decided in favor of municipal ownership of their street railway system.

Winnipeg, Man.

Tenders received until May 5 for underground conduit material.

Tenders are called to May 8 for six 100 kw. oil-insulated, self-cooled transformers; two 13,000 volt electrolytic lightning arresters and six 100 amp. choke coils, for Beausejour & Stony Mountain sub-stations.

The Fort Garry Hotel, Winnipeg, was recently the recipient of probably the largest single shipment ever sent out from the Amherst Plant of the International Engineering Works, Limited. This hotel, which is being erected by the Grand Trunk Pacific Railway Company is to have a complete power plant furnished by the above company. It will consist of four 300 horse-power Robb-Brady Scotch boilers and three vertical high-speed cross-compound engines with two duplex air compressors, smoke connection for the boilers, and auxiliary apparatus. The boilers weigh 32 tons each, are 10 feet in diameter by 17 feet long, with double furnaces 4 feet in diameter by 14 feet 2 inches long.

Yarmouth, N.S.

An electric fire alarm system is contemplated.

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An Association on Broader Lines

There has prevailed for some time quite a strong feeling in favor of the organization in Canada of an electrical association on somewhat broader lines than any of the existing associations. This statement, while admittedly true, is not intended to be interpreted as questioning the usefulness of such organizations as the Canadian Electrical Association, designed more particularly to protect and promote the interests of privately owned central stations; the Ontario Municipal Electric Association, essentially for officials and representatives of municipal plants; the Canadian branches of the American Institute of Electrical Engineers, composed more particularly of the technically trained engineers; the Jovian Order, and such other organizations as may exist. Each society is doubtless doing some good work and has its enthusiastic supporters. But it is thought that an organization which will bring together men engaged in all branches of the electrical business, for social intercourse and for friendly discussion of technical and commercial problems of interest to all, would result in much good. The tendency to-day is, we believe, towards over-organization—too many requests to join this and that society—but that is no reason why we should not have a comprehensive association, presumably with provincial sections, for the electrical people of Canada.

At a recent meeting in Toronto of the Managing Committee of the Canadian Electrical Association, the advantages of a broader association were discussed. It was clearly shown that there is a strong desire to continue to receive the benefits to be derived from the present affiliation with the National Electric Light Association—benefits which are recognized by every central station company. There were also many present who favored a more comprehensive association, and after an open discussion a resolution was adopted requesting the Electrical News to take steps to gather the opinions of representative members of the electrical industry on the advisability of bringing into existence an organization on broad lines, whether through the C. E. A. or as a separate association being a matter to be decided later. A letter explaining the situation and requesting an expression of opinion has in consequence been sent to a large number of our readers and others who would be interested.

Those who have not already responded to the circular are urged to do so at once, so that the Committee may have the information as soon as possible. If any of our readers have not received a copy of the circular letter they are asked to consider this as an invitation to send in an expression of opinion, as the best results can only follow a very general and prompt response to the request.

New Rules and Regulations

The Hydro-electric Power Commission of Ontario have just issued their new "Rules and Regulations" for inside electrical installations, including also rules on signalling systems, wireless telegraph apparatus, electric railway work, etc. It will be remembered that some time ago a preliminary copy of these rules appeared which met with considerable opposition. As a result the present rules are framed according to somewhat different standards and now correspond very closely, in the main, to the National Code. The Commission's rules, however, are a distinct advance at certain points over the National Code rules. The Ontario rules cover quite thoroughly the question of life hazards, not included in the National Code. The arrangement under the different headings is also much better. For example, in the National Code, the wiring requirements in connection with switches and cutouts are found in about thirty different places, whereas in the Ontario rules these are all compiled under one heading. The contents are properly indexed and it is now an easy matter to place one's finger on the particular item required. The Ontario rules also contain a certain amount of detail not found in the National Code.

The "rules and regulations" specify further that all materials, fittings, devices, etc., which have been formally approved, without question, by the Commission. The Commission, however, do not tie themselves by any hard and fast rule to the Underwriters' Laboratories approval, but will permit the use of any material where it is demonstrated to the satisfaction of the Commission that this material is up to the standard set by the Chicago Laboratories.

Another, and most important provision in connection with the new rules is that requiring the appointment of inspectors, by the corporation of any municipality, for the purpose of enforcing due observance of the regulations. It is understood to be the intention of the Commission to insist on properly qualified inspectors. Wherever possible, these inspectors will have no other duties, combining, rather, the work of two or three or more municipalities, so as to occupy their time fully. While the appointment of inspectors by the various municipalities is not intended to insinuate that there has been anything like a universal slackness in connection with the installation of wiring throughout Ontario, yet the fact that there are a number of installations which are recognized as unsafe has no doubt influenced the Commission to institute a proper system of inspection covering the whole province. It is quite within the range of possibility that the trouble in Oakville would have been averted under proper inspection even without the grounding of the service transformers, and the same is true of more than one other fatality and semi-fatility that we can recall during the last few years.

And no less important than the appointment of these

inspectors is the system by which the inspectors shall be inspected and the work throughout the province standardized and maintained according to a proper ideal. This will be one of the most difficult matters in connection with the working out of the system and it will be an early move on the part of the Commission to establish an inspection department controlled by a suitable head, who will be responsible to the Commission direct and be in no way subservient to any other department. Such an arrangement will require a man who at the same time possesses accurate engineering knowledge, and is in touch with the practical requirements of the department, and who is beyond the reach of outside influences in the rigid interpretation and enforcement of the rules. It is only justice to the various interests concerned, both private and municipal, that a man of this type, as nearly as possible acceptable to all, and possessing the confidence of all, should be placed in charge and given a free hand.

The Oakville Accident

The unfortunate occurrence in Oakville which resulted in the death of two persons by electrocution is not surrounded by any mystery, as has been stated, but was satisfactorily, if not immediately, located by the engineers who were called in to make a report. The situation in the town of Oakville is as follows: power is supplied to the town by a private company, the Dominion Power & Transmission Company, and sold off their high voltage line to the municipality of Oakville. The municipality, on its part, transforms down to 1300 volts for a series street lighting system and to 2200 volts for a distribution net work for house lighting. The 2200 volt line is again reduced by pole-type transformers to 110 volts. It appears that at some time previous to the accident the 1300 volt line came, by some means, short circuited with the 2200 volt line. Also the 1300 volt line was shorted on to the 110 volt line at two points, these two points happening to be fed from different service transformers. In each case, therefore, the man who touched the wires completed the circuit from a 2200 volt line to ground. It was therefore of no significance that the street lights were on in one case and off in the other.

It is often difficult to lay one's finger on the particular defect in a system which is responsible for trouble, but in this case it is clear that if the secondaries of the service transformers had been grounded, the accidents could not have happened. The question of whether it is best to ground is one that has been freely discussed in the past few years, and different opinions have been held, but in later years engineers have come to look with disfavor on the system of installation found in Oakville. The practice of grounding the secondary transformers is now followed by the Toronto Electric Light Company, the Toronto Hydro-electric System, the Montreal L. H. & P. Company, the Electric Power Company's numerous systems in central Ontario, and many others.

The new regulation contained in the Hydro-electric Power Commission's rules, just issued, that everything below 150 volts must be grounded, is therefore most opportune. We understand also the National Code will, in its new edition to be out towards the end of the present year, contain the same requirements. This, with the added condition of rigid inspection which is included in the rules and regulations of the Ontario Commission, should make a repetition of the Oakville fatality a practical impossibility.

In other respects, too, the regulations of the National Code when not observed in Oakville in that the type of flexible cord used was not up to the standard specification. Neither was the portable lamp supplied with the necessary insulating handle. Had these regulations been observed, it is fairly certain that one at least of the fatalities would not have occurred.

Which all goes to show that it is not the lack of knowledge or rules or regulations in such matters, but that it is the carelessness or indifference which fails to observe the rules that causes most of the accidents due to the operations of electric currents.

The Toronto Hydro-electric Commission

It has been said that the Ontario Government's delay in filling the vacancy on the Toronto Hydro-electric Commission caused by Mr. Drayton's elevation to the Railway Board, is due to difficulty in locating a suitable man who will undertake to give the necessary thought and time to the office. No doubt this is correct for the very reason that any man who possesses the necessary qualifications to make him desirable in this position is, in the nature of things, so occupied with his own business that he cannot spare the time to any semi-philanthropic scheme that might easily occupy several hours of each day. Added to this, a position on the Board carries with it the inevitable exposure to criticism on the part of the public and the press, which cannot help, and generally renders much more difficult, the pursuit of any definite line of policy. And not only is this criticism misplaced, but it is at the same time very irritating to most good men. That the present chairman of the Board has given freely of his valuable time and has, almost without comment, run the gauntlet of much ill-advised and uncalled for criticism, proves only Mr. Ellis' ideal of "public service," but does not suggest any argument, other than that contained in these two words, which is likely to appeal to the type of man we need to sit with Mr. Ellis on the Toronto Hydro-electric Board.

In justice to the present chairman, however, who cannot be expected to continually neglect his own private business and to carry the responsibility of the city's hydro-electric system alone, we believe the government would be well advised in making an early appointment to the vacant office. The name that appears to suggest itself most naturally is that of Mr. A. Claude Macdonell, M.P. for South Toronto. Mr. Macdonell is known as a man who "does things," and having become acquainted with the demands of public life, he has grown, we may suppose, somewhat impervious to the poisoned darts of public fault-finding. It is said that he would not accept the appointment but we are loath to believe that Mr. Macdonell's high sense of public duty would not be sufficient to lead him to accept any position where there is scope for the exercise of his executive ability in useful service to the city of Toronto.

With P. W. Ellis, A. C. Macdonell and Mayor Hocken composing the Hydro board, it is difficult to conceive of many serious errors or omissions in the carrying forward of the citizens' work. If Mayor Hocken really cannot spare the time, it is conceivable that Mr. J. W. Woods may be induced to step into the breach. Perhaps after all, the removal of the mayor from this Board would be best, for although Mr. Hocken would undoubtedly add much strength to the Commission, it is well to remember that Toronto is no longer a village and that the general organization of the city's business requires the undivided attention of even so capable a mayor as Toronto is at present blessed with. The removal of the mayor's name from the Board and the substitution of that of Mr. Woods would also give continuity to the work of the Commission.

It is understood that the Vancouver Public Service Corporation will shortly commence work on its project of generating steam heat and electric power from the refuse at the various city mills, for distribution throughout the city of Vancouver in accordance with an agreement with the city council, recently endorsed by the ratepayers.

Generating Power at the Mine

Mr. L. S. Cockburn, B.A.Sc., recently delivered an address before the Society of Engineers of Saskatchewan and the members of the Board of Trade at Regina, dealing with the production of power for lignite coal and its transimssion to Moose Jaw and Regina. Moose Jaw is situated 25 miles from the point in the coal fields at which it was proposed to install the plant, and Regina is 41 miles farther south. The estimates are figured on an initial generation of 6,000 kilowatts in a power house so designed as to allow of indefinite extension. The boiler plant estimated on would consist of nine boilers of approximately 1,000 h.p. each, at 150 lbs. pressure, which would drive four 1,500 kw. turbo-generators.

The cost of the generating plant is put at $470,000, made up as follows: buildings, $20,000; boiler plant, pipe and coal and ash handling equipment, $180,000; four turbo-generators with necessary step-up transformers and auxiliary equipment, $270,000.

Transmission at 44,000 volts is suggested and estimates are made on a single circuit wood pole line, a double circuit wood pole line and a metal tower line. These are estimated to cost respectively $127,540, $171,120 and $258,438, size No. 1 wire being used from the plant to Moose Jaw and size No. 4 wire from Moose Jaw to Regina.

The sub-stations are placed at $50,000 for Moose Jaw and $70,000 for Regina. The Moose Jaw equipment would consist of three 800 kw. transformers and a rotary converter of 500 kw. capacity. The Regina equipment would be four 900 kw. transformers and two rotary converters of 500 kw. each. This brings the total cost of $820,000 made up as follows: generating station, $470,000; transmission line, $171,120 (double circuit wooden pole line); sub-stations, $120,000; engineering and incidentals, $58,800. To this is added $25,000 for the cost of the coal mining equipment making a total of $845,000 for the investment.

The fixed charges are figured at $168,200, made up of $90,000 interest and sinking fund at $78,200 operating expenses. This figures out to 1.53c. per kw. hour on the combined consumption calculating a 25 per cent. load factor. Figures were given showing a reduction in rate per kw. hour to .66c. as the load factor gradually increased to 90 per cent.

International Electrotechnical Commission

The dates for the next Congress of the International Electrotechnical Commission, which is to be held in Berlin, Germany, have just been settled, the announcement now being made that the first meeting will open in that city on the 2nd of September next, and that the gatherings will continue for the balance of that week. This Commission is an international body engaged in the world-wide standardization of the fundamental units used in all electrical work, the terms employed to describe various types of machinery, the nomenclature and symbols current in electrical text books and other allied literature, and the methods of testing electrical apparatus, etc., a work always important, but more especially so in view of the enormous increase in the use of electric motors, lights, and devices, which has taken place in the last few years. There are about twenty member countries in the Commission, comprising practically all the European nations, besides for instance such widely scattered memberships as Japan, Brazil, and Mexico, in view of which it is apparent that the rulings of the Commission are the product of experience gained from almost every conceivable condition under which electrical apparatus can be manufactured and operated. Further, as the individual members are in the forefront of electrical work in their respective countries, the decisions of the Commission form the most complete and satisfactory international standards that can possibly be produced.

The Canadian and other National Committees have for some time had under consideration the rulings proposed by two important sub-committees, namely, on symbols and on rating, and the various amendments suggested by them were discussed very fully at the sub-committee meetings lately held in Zurich, Switzerland. One of the main questions raised regarding symbols was the selection of suitable characters to distinguish between vector and scalar quantities and between electric and magnetic quantities, a point on which there was a long discussion both in some of the National Committees and also at Zurich. The final decision, it has been pointed out, should take into consideration not only the technical aspects but also the very practical point as to what characters will be most readily available on a typewriter or type-setting machine. The report on the Rating of Electrical Apparatus will likely be amended in one or two interesting points; for instance, it is suggested that ultimate temperature, and not temperature rise, be standardized as the basis of rating, on the ground that it is really the former that governs the life of the apparatus which may be in question. Further, the term "cooling-air" is proposed as a substitute for the time-honored phrase "surrounding air," the change obviously being suggested with reference to the modern practice of forced ventilation. These proposed rulings, in their ultimately amended form, will go before the plenary meeting at Berlin for final and official ratification, besides which there are, of course, a number of other important recommendations to be considered.

The question of Canadian representation at the Berlin Congress is also one that has to be decided very shortly by the Canadian Committee, the matter being to a certain extent one of finances. Previous delegates have been Dr. L. A. Herdt, who attended the preliminary meeting in London in 1906, at which time the statutes of the Commission were drawn up; Mr. Ormond Higman, who went to the London Conference in 1908, and Prof. L. W. Gill, of Queen's University, who represented Canada at the 1911 Congress in Turin, Italy.

German Electro-Technical Industry

According to a report just issued by the German Union of Electro-Technical Manufacturers, the past year was a good one for the industry, the marked increase in the adoption of electricity for lighting and power purposes reflecting itself in increased turnover by most members of the union. Profits, however, chiefly owing to the advance in metal prices, were not always satisfactory. The union includes almost all the German electrical companies outside the A. E. G. and Siemens Schuckert groups. Makers of motors were well employed, but unfortunately it was only possible to obtain better prices for those of upward of 5 horse-power. The cable branch of the industry had little reason to complain, for owing to the efforts of the Cable Cartel prices were brought to profitable levels. Foreign competition was very keen. Prices of insulated wire, which were very unsatisfactory in 1911, were improved, producers coming to a price agreement. Toward the close of 1912 a price cartel was formed with regard to insulating tubing, the manufacture of which had become quite unprofitable. There was a slight improvement in arc lamp trade owing to the introduction of new and improved types, but the incandescent lamp trade left much to be desired. The German tax on lighting apparatus is seriously handicapping both the home and foreign trade. Owing to the customs practice in the United States and Canada of including the German lighting tax as part of the basic price on which to impose their own ad valorem import duty, it is now proving quite impossible to export German electric lamps to these markets.—Daily Consular and Trade Reports.

Electrical Contracts Let

At the annual meeting of the Western Canada Power Company, held in Montreal, Mr. C. H. Cahan, K.C., the president, stated that in addition to ordering two additional 13,000 horse power double Francis turbines from Escher, Wyss & Company, the directors had given a contract to the Canadian General Electric Company for two generators, and had ordered from the Canadian Westinghouse Company the switchboards and accessories to complete the power house to double its present capacity. Although under its contract, which was recently completed, the British Columbia Electric Railway Company, Limited, was not actually required to take electric power from the Western Canada Company before September 1st next, that company had already commenced to take 6,000 horse power.

Mr. Cahan added: "The establishment of grain elevators, flour mills and cement mills, together with the new steel works, which will soon be in operation in Vancouver, will ensure large increases in our sales of power, and we must now prepare for the large demand which these industries will certainly make upon us."

The following were elected directors of the company for the ensuing year: C. H. Cahan, A. R. Doble, T. J. Drummond, Wm. McNeil, Campbell Sweeney, A. H. B. MacKenzie, R. F. Hayward and DeForest Hicks. Mr. Cahan was subsequently re-elected president; Mr. T. J. Drummond, vice-president; and Mr. O. B. MacCallum, secretary-treasurer.

Underground Conduit in Montreal

Mr. G. M. Gest, of Montreal and New York, has been awarded the contract for constructing the first section of the underground conduit system as planned by the Montreal Electric Service Commission. There were four tenders submitted, and the Commission recommended that the tender of Mr. Gest, at $271,758, be accepted.

This will be one of the most complicated pieces of work ever undertaken, the construction being under the sidewalks on St. Catharine street, the most congested street in the city. Mr. Gest has agreed to complete the work in six months, while the next lowest tenderer asked twenty-four months.

The City of Montreal is fortunate in securing so favorable a tender from Mr. Gest, as his long experience in specializing in conduit work, together with his capable organization, is a guarantee of first-class construction and thorough satisfaction. We know of no one better qualified to lay out and build a conduit and distribution system than Mr. Gest, and his willingness to undertake the completion of this important work in six months' time speaks volumes for his organization.

65,000 h.p. for Laurentide Pulp

The Laurentide Pulp Company, are planning big extensions to their plant at Grand Mere, Que., at a cost of approximately $1,000,000 and one of the most interesting features from the viewpoint of electrical engineers will be the building of a large new power house capable of developing 65,000 h.p. Application has been made to the Department of Public Works for permission to construct a dam across the St. Maurice River at Grand Mere. In the official application permission is asked for the right to use all the water power of the river at Grand Mere, with the exception of such as may be used for the sluicing of logs over the proposed dam. The dam is to be a concrete structure with sluice gates and a spillway 1,900 feet long.

The power house will have eight main power units with space for two more units when required. It is understood that the application will come before the cabinet council in the course of a few days and will be granted. The enlargement to the plant of the Laurentide Pulp Company will mean permanent employment for a large staff of extra men when completed.

Economy Test of a 200 h.p. Robb Scotch Boiler

There was recently conducted a 12-hour test of a 200 h.p. Robb Scotch boiler, a modification of the standard Scotch internally fired type. It evaporated 11.8 pounds of water per pound of combustible giving a combined boiler and furnace efficiency of 73 per cent. and this in spite of the fact that the boiler carried an average of 22 per cent. overload. While possessing the features which make the Scotch marine boiler so satisfactory and efficient, this modification embodies a few changes to increase the circulation. A cylindrical baffle plate open at the bottom and extending about 1-3 the length of the tubes carries the water to the bottom of the boiler from which it rises between the furnace and amongst the tubes and again enters the smaller upper drum by means of a neck.

In this test a good grade of semi-bituminous coal was used which analyzed as follows: volatile matter, 18.78; fixed carbon, 75.62; ash, 5.60. The test was conducted with running start and stop.

Among the more important data may be mentioned an average flue temperature of 507°, a combined furnace and boiler efficiency of 73 per cent., and a percentage of 22.35 over builders rating. The escaping flue gases average 10.81 per cent. of CO_2 with only 0.32 per cent. of CO. It is estimated from the analysis of the flue gases that a little over 18 pounds of air was supplied to a pound of coal burned.

The following table gives the heat balances:

	B.t.u.		%
Heat usefully expended, per lb. dry coal	10,826.0	=	73.00
Heat lost in moisture in steam	27.5	=	0.18
Heat lost in evaporating moisture in coal	28.7	=	0.19
Heat lost in combustible in refuse	307.6	=	2.07
Heat lost in unconsumed gases	248.1	=	16.88
Heat lost in moisture formed by burning H in coal	499.2	=	3.37
Heat lost in escaping gases above temp. of steam	796.2	=	5.37
Heat lost in escaping gases below temp. of steam	1,440.3	=	9.72
Heat lost in radiation and unaccounted for	657.4	=	4.42

While this test gives very satisfactory figures regarding this boiler, the figures might have been still better had it not been for the fact that the bridge wall was reduced as it was thought that the draft would be so restricted that the boiler could not carry the load of the mill. Cutting down the bridge wall nearly level with the grates resulted in a considerable loss of coal and coke into the combustion chamber. The amount of this loss was not determined, but is included in the "radiation and unaccounted for" losses which amounted to 4.42 per cent.

Fifth Hydro Report

The Hydro-electric Power Commission of Ontario has just issued the 5th annual report of its operations for the year ending October 31, 1912. Following so closely on the 1910 and 1911 reports, the 1912 issue comes somewhat as a surprise, and we are pleased to note the businesslike promptness which actuated the Commission to publish this report before all the matter contained in it should have become ancient history. The contents are classed under five headings of legal proceedings, transmission systems, operation of the systems, municipal work and hydraulic investigations. In addition to many interesting photographs a map of Ontario showing the operations in the Niagara district, the Severn district, the Morrisburg district and the Port Arthur district, outlines the work of the Commission to date.

Ties Used in 1912

Advance Government reports show that a total of 16,619,362 cross ties were purchased by Canadian steam and electric railway companies in 1912. This is an actual increase of 2,230,138 ties or 15.5 per cent. of the total number purchased in 1911. The total value of these ties at the point of purchase was $7,469,336 being an average of 45 cents per tie. The average price in 1911 was 39 cents and the increase of 6 cents in 1912 is due to the increases in the prices of Jack pine and cedar ties which were purchased in greatest quantities in 1912.

Jack pine still heads the list although fewer ties of this material were purchased than in the preceding year. The greatest increase in the use of any one kind of wood was in the case of Eastern cedar which moved up from fourth to second place on the list. The great variation in the use of this material from year to year is an indication of the uncertainty of the supply.

The use of Douglas fir and hemlock increased and these two kinds of wood retained their relative places on the list. One of the greatest decreases was in the use of tamarack which dropped from fifth to ninth place on the list. This is another wood of which the supply is uncertain.

The four hardwoods, oak, beech, maple and birch were all used in greatly increased quantities, indicating the general tendency of railways operating fast, heavy trains to reduce the use of cedar and other soft, weak woods, and to increase the use of hardwoods or chemically treated Southern hard pine. In all, nineteen different kinds of wood were used for cross-ties in 1912.

Table Showing Total Ties Used

	1911		1912	
Kind of Wood	Average value	Per cent.	Average value	Per cent.
Jack pine	.41	37.9	.46	28.8
Cedar	.40	10.0	.45	19.7
Douglas fir	.38	13.5	.30	13.1
Hemlock	.35	11.6	.38	11.7
Western larch	.43	8.3	.43	7.2
Oak	.81	1.0	.67	5.6
Hard pine	1.11	a	.66	4.0
Eastern spruce	.26	6.3	.39	3.4
Tamarack	.32	9.7	.53	2.6
Chestnut	.56	.5	.59	1.6
Beech	.21	a	.68	.6
Western cedar	.42	.4	.35	.5
Maple	.21	.1	.77	.3
White pine	.29	a	.35	.3
Birch	.21	.1	.60	.2
Red pine	.32	.5	.48	.2
Balsam fir	——	—	.13	.1
Western spruce	——	—	.58	a
Elm	.43	a	.47	a
Poplar	.27	a	——	——
Black ash	.43	a	——	——
Total	$.39	100.0	$.45	100.0

a = less than one-tenth of one per cent.

The steam railways in 1912 purchased a total of 16,136,600 ties, 97.1 per cent. of the total number purchased in Canada. These railways used all the Western larch, chestnut, beech, maple, birch, red pine and balsam ties.

The electric railways, using less than three per cent. of all the ties, purchased cedar in greater quantities than any other material. Ties used by these railways are not required to carry the heavy loads and endure the excessive rail cutting that is experienced on steam railway roadbeds. Oak and elm are the only hardwoods used by these railways, although imported hard pine is used to a slight extent. Durability in contact with the soil is of more importance for this purpose than strength or resistance to wear.

Ties Used by Electric Railways Alone

	1911		1912	
Kind of Wood	Average value	Per cent.	Average value	Per cent.
Cedar	$.41	28.0	$ .55	33.0
Douglas fir	.20	55.0	.43	32.5
Hemlock	.37	2.7	.44	10.9
Tamarack	.18	4.0	.61	6.5
Jack pine	.47	3.7	.58	5.3
Western cedar	——	——	.51	5.2
Eastern spruce	.25	.9	.34	3.4
Western spruce	——	——	.58	1.7
Hard pine	——	——	.70	.9
Oak	.61	.9	.82	.6
White pine	.41	.4	2.12	a
Elm	——	——	1.74	a
Red pine	.47	3.7	——	——
Chestnut	.46	.2	——	——
Total	$.29	100.0	$.52	100.0

a = less than one tenth of one per cent.

There is a noticeable increase in the use of chemically treated ties by Canadian railways. In 1911 only 206,209 ties or 1.4 per cent. of the total were treated chemically to prevent decay. In 1912 a total of 1,518,189 ties or 9.1 per cent. received chemical treatment. The Canadian railways are evidently taking advantage of the saving that can be accomplished by the use of preservative treatment of cross ties. The accompanying tables give, in detail, the percentages and prices of each kind of wood.

Horse Vehicles in Central-Station Service

During the year 1912 the Commonwealth Edison Company had 130 horses, 107 horse vehicles and 72 electric vehicles in service. Allowing a deduction of 6 per cent. in the number of wagons in service at a time because of repairs or of horses being shod, idle or sick, there remain 101 horse vehicles with which to average the expenses. These expenditures are grouped under the following heads:

Feeding, shoeing and veterinary service	$29,712
Labor in barns and repairs to buildings	20,176
Repairs on horse vehicles	11,088
Total for the year 1912	$60,976
Cost per horse vehicle per month	$50.31
Driver's salary	60.00
Supervision per vehicle per month	4.6
Rent of barn per vehicle per month	4.05
Municipal wheel tax per month	0.4
Interest at 5 per cent., depreciation at 10 per cent., taxes at 1.5 per cent., insurance at 1 per cent.	5.73
Total cost per month	$125.18
Average cost per day per horse vehicle in service, on the basis of 25.5 days a month	$4.91

Twenty of the seventy-two electric vehicles owned by this company are used in carrying supplies from warehouses to customers' premises. About thirteen cars are employed for making lamp renewals, and ten trucks are used for installing small overhead-line extensions which do not involve the setting of poles. The remaining vehicles are used for delivering meters, for underground-line work, installing signs and pulling cables through conduits by means of the vehicle motors.

In size the electric vehicles range from 700 lb. to 4,000 lb. in carrying capacity, the average being about 2,500 lb. As the average time that they have been in service is about twenty-six months, the owner figures that the maintenance charges have reached a value that can be regarded as fairly typical of the service.

The electric wagons used by the overhead department were designed to carry all of the tools and materials used for

installing the customer's service wires. Compartments for holding the supplies are arranged so as to be readily accessible to the linemen. Above these compartments are racks for holding cross-arms. Hooks are arranged on both sides of the truck for supporting coils of ropes and extension ladders. There is no room on the truck for anything except what is absolutely required, thus preventing the accumulation of junk.

In addition to the seventy-two electric commercial vehicles mentioned, the Commonwealth Edison Company owns three large electric trucks capable of carrying 3.5, 5 and 6 tons each. The largest one is used for hauling coal and the other two are employed for carrying reels of cable. The results obtained with the electric vehicles have been so satisfactory that this company is contemplating placing in service thirty more, some of which have been ordered already.

Operating Expenses for Electric Vehicles

Operating, repair and other maintenance charges on the electric vehicles owned by the Commonwealth Edison Company for the year 1912 are tabulated below. The number of vehicles in service at a time is taken as forty-seven in averaging the operating expenses.

DATA ON COMMONWEALTH EDISON ELECTRIC VEHICLES

Expenses	Total 1912	Cost per Month per Vehicle in Service	Cost per Day per Vehicle in Service
Supplies	$2,938	$5.21	$0.20
Painting	901	1.60	0.06
Tire replacement	2,838	5.03	0.20
Battery repairs	4,858	8.61	0.34
General Repairs	11,574	20.52	0.81
Washing, placing wagons on charge and minor repairs	8,136	14.43	0.57
Maintenance of garage building, including rental	8,243	14.59	0.57
Total	$39,488	$69.99	$2.75
Operating and repairs as shown above	......	$69.99	$2.75
Energy, at 4 cents	......	17.68	0.69
Driver's salary	......	65.00	2.55
Supervision	......	4.72	0.19
Wheel tax and state license	......	2.50	0.10
Depreciation (total cost of wagon less original cost of tires and battery spread over eight years)	......	20.00	0.79
Interest, taxes and insurance	......	8.33	0.33
	......	$188.22	$7.40

Average miles per vehicle per month 749.

Although the maintenance charges on electric vehicles are about 50 per cent. more than those on horse vehicles, this increased expense is more than offset by the saving in time in traveling from one job to another. A horse vehicle can cover about 15 miles a day in delivery work, while an electric vehicle averages about 29 miles a day on similar work. The saving may not be apparent here, but in case men who are paid 40 cents an hour are being transported to a job, any time saved represents a net profit.

Kent Electric Co.

The Kent Electric Company of Richibucto, N.B., commenced operations in 1905. The power station is in connection with the saw mill at that point and so the engine which supplied power to the mill during the day time is used to operate the generator at night. In July, 1911, this company was taken over by the Swedish Canadian Lumber Company, but operates still under the old name. This company is now supplying electric light for streets and interiors in both Richibucto and Rexton. The annual output is about 30,000 kw. hours, the generating equipment consisting of a 250 kw. a.c. Royal Electric generator, single-phase, 60-cycle, 2200 volts. Carbon lamps are used on the streets.

The manager of the company is Mr. O. W. Nordin, but the business is in charge of Mr. A. Kulinder, former manager of the company's mills in Rexton and Richibucto, but now assistant general manager of the company. The chief engineer and superintendent is Mr. Lester Brown who has been connected with the plant since its inception.

Protection for Electric Circuits

By Mr. W. G. Merowitz

Of the five general classes into which all electrical apparatus may be divided, namely, generation, transformation, utilization, control and protection, the latter class, that of protective apparatus, appeals to the writer as being the most important. For the designer of the present day has not given to us apparatus which will be immune from destruction, due to a dead short circuit or other abnormal condition of the circuit, without a protective device.

Protective devices may be classed as, circuit breakers, oil switches, relays and systems which include relays, switches and circuit breakers. Every protective device of the circuit breaker or oil switch class must be capable of performing two functions; (1) that of carrying the current continuously without undue heating and (2) that of satisfactorily interrupting the energy which is in the circuit at time of abnormal conditions. Contrary to the general impression regarding protective devices, their main use is not to open the circuit but to keep the circuit closed, except in such cases where opening is absolutely necessary in order to prevent immediate destruction of the protective apparatus. The fallacy that the function of a protective device is to open the circuit on any and all occasions is the basis of a somewhat false design and poor operation with some types of devices now on the market.

If electric generating or power machinery would stand overloads and short-circuits, there would be no necessity for protective devices. Central stations are in business to sell current and anything that tends to interrupt the continuity of service tends to not only cut the earnings of the company but also to irritate the customer. It is only because we are called upon to handle enormous energies, which produce disastrous results on short-circuits or other abnormal conditions, that protective devices are needed. Since the protective device is the link between the various classes of apparatus, generating, transforming, utilizing and controlling electricity, it follows that the successful operation of the station, depends upon the successful operation of the protective device.

Considering now the first function, which every device for protection must fulfil, that of carrying current continuously. All devices, whether carbon circuit breakers or oil switches, must fulfil this function, regardless, whether it is used to protect a one horse-power motor or a 20,000 kw. generator. It is always, in series with the apparatus it protects, and must therefore carry the same current continuously. In this respect, there should be a broad line drawn between protective devices and controlling devices, as controlling devices are only used during the starting period and hence, carry the current for only a short time.

Of course, the most satisfactory joint for carrying the current continuously is a well soldered joint, and this is followed by bolted and by laminated joints. Blade contacts, clip contacts and butt contacts are also used. As it is necessary to use a joint which can be easily closed and opened, it is readily seen that the soldered or bolted joints cannot be used and the laminated joint comes next in efficiency as a current-carrying member. The laminated brush posesses the advantages of not only being able to make and maintain a good contact, but can be easily removed from the contact to open the circuit. When the laminated brush is correctly made and used it is the best current-carrying member employed for either carbon break circuit breakers or oil switches. Whatever kind of contact is used, it should be of such design as to be able to efficiently take care of the full load current of the switch, with a rise of not more than 30° C. A higher rise

than this would heat the oil and experiments show that heated oil is not so effective as cool oil, in quenching the arc.

And now, considering the second function which a protective device must fulfil, that of satisfactorily interrupting the energy at abnormal times. It seems pretty well proven that, for direct current circuits, carbon-break circuit breakers, of ample size are entirely satisfactory. If the resistance of the carbons is low at the instant of the break (not when the breaker is closed) and if the break is wide enough such a circuit breaker when properly mounted will open any short circuit which it may be called upon to handle. For a.c. circuits, however, a carbon-break circuit breaker is not so satisfactory, even on low voltage installations, as long flaring arcs, due to the inductive discharge of the circuit, not only burn the contacts but create a disastrous rise of voltage, which at times will be large enough to break down the insulation and start a fire. Oil switches, on the other hand, break the arc in a bath of oil and when these switches are provided with the proper form of contact for carrying the current, there is no excuse for using carbon-break breakers for alternating current, whether the voltage is 110,000 or 110; the oil switch being in most cases cheaper and in all cases more satisfactory.

Other things being equal, the oil switch which has the strongest mechanical structure, the strongest oil tank and the greatest head of oil over the break, will open the most energy. These points can easily be determined by inspection of the switch. It is not always the best policy to purchase circuit-breaking devices which can be depended upon to break extremely heavy short circuits, as the cost of real estate in some cases would render such an installation prohibitive and as the possibility of these extremely heavy short circuits may be exceedingly remote. But, nowhere is economy so unjustly exercised as when applied to the purchasing of protective devices and in no other class of apparatus should price be given as little consideration. The price of even the most expensive and best of these devices is almost nothing compared with the cost of apparatus which they protect and a few dollars saved on these devices may not only wreck the station apparatus but throw an entire section into darkness.

Relays are used to control the action of various kinds of oil switches and circuit breakers. The function of relays, is to cause the switch to open at any pre-determined point or condition of the circuit. The relay should be selected, not with the view of protecting apparatus, but of maintaining the service and that the circuit may only be opened when it was absolutely necesary to do so in order to prevent the apparatus from being destroyed and the line from being shut down altogether.

Synchronizing Force in Hunting

By Dr. Steinmetz before A.I.E.E.

If two synchronous machines, such as converters, are connected together slightly out of step, or are thrown somewhat out of step by some other means, the machine in which the rotor is ahead of the position of mean rotation (i.e., the "leading machine") gives more power and so slows down, while the "lagging machine" gives less power and so speeds up, and the machines thus come nearer together.

However, when they are in step, the machine which was formerly leading, being slower in speed, still loses, and thereby drops behind; while the machine which was formerly lagging gains due to its higher speed, and thus runs ahead, and the machines again pull apart, this time in the opposite direction. This goes on until the increased load on the leading machine retards it and once more causes it to drop back; while the decrease of load on the lagging machine causes it to speed up and gain. In this manner by a number of successive oscillations the machines settle down into step. If there were no losses, at every swing the machines would pull apart again as much as they were apart in the preceding swing; but, owing to the energy losses caused by the oscillations, the swings decrease the more as more energy is dissipated by them, and the oscillation thus is damped out. This is not hunting, but the natural and inherent adjustment into step by a decaying oscillation.

The pulling together of synchronous machines is the result of the increase of load on the leading machine, which retards it, and the decrease of load on the lagging machine, which accelerates it; and the change of load with the change of the relative position of the machines thus is called their "synchronizing power." That is, we may consider—and if the machines are running at no load, this is actnally the case—that the leading machine transmits power to the lagging machine, and that hence an interchange of power occurs. If there were no interchange of power with the relative position—that is to say, if the running ahead of a machine would not put any load on it, and inversely—there would be nothing to stop the machines from drifting out of step with each other. If the running ahead of a machine would decrease the load on it—as is the case in series connections of two alternators—it would continue to run ahead with increasing force, i.e., the conditions of "instepness" would be unstable, and equilibrium and synchronous operation impracticable.

Result of Position Displacement

The synchronizing power, i.e., the power exerted by one machine upon the other, is the result of a position displacement of the machines, and is thus the cause of the possibility of parallel operation. The synchronizing power is, approximately, proportional to the displacement in position; if the two machines are thrown out of step by twice the angle (i.e., the one pushed ahead, and the other back, from its mean position by twice the position angle) obviously the exchange of current, and thus of power, is approximately twice as before.

Synchronizing force, i.e., the force with which the leading machine is pushed back and the lagging machine forward, thus is (approximately) proportional to the amount of lead or lag of the respective machines; and, as a result, the force with which a machine runs ahead, is held back and finally stopped, is the same as the force with which it moves back into step again and then out of step in the opposite direction. This, however, is the case only if there are no losses and no lag of the synchronizing force behind the position displacement.

The result of losses is that the machines are held back from going apart with greater force than they are pushed together again, and thus on the next swing go apart less, i.e., gradually settle into step.

The result of a lag of synchronizing force behind the position displacement is that, when the displacement increases (i.e., the machines pull apart), the opposing synchronizing force is less than it is when the machines come together again; and the machines thus are pushed together at an increased energy, and on the next swing go apart further. In other words, the result of a lag of the synchronizing force behind the position displacement is an increase of the successive swings; a cumulative oscillation, or hunting. Thus hunting is not an incident of synchronizing force or insufficiency of it; but is the result of a lag of the synchronizing force behind the displacement in position which produces the synchronizing force, and is thus a true hysteresis effect, i.e., a "lagging." If there is no lag of the synchronizing force, there can be no cumulative oscillation, i.e. no hunting; but, since energy losses must always be present the machines must steady down to rest

The relation between mechanical momentum and magnetic forces, the frequency and intensity of energy impulse.

etc., have no direct bearing on the phenomenon of hunting, however important they may be; but merely determine the frequency of the synchronizing oscillation, and thus of the hunting, if it can occur, and to some extent the rapidity of its increase.

If a lag of the synchronizing force is present—and some lag almost always exists—hunting would occur if the cumulative energy resulting from this lag is greater than the energy losses due to the oscillation. If the energy losses are greater, hunting does not occur; but the energy losses decrease the oscillation more rapidly than the lag of the synchronizing force increases it.

Practically all anti-hunting devices—i.e., devices which dampen oscillation by energy dissipation, such as short-circuit conductors around the poles, between the poles, a complete squirrel cage winding, etc.—also cause more or less lag of the synchronizing force, and thereby increase the hunting energy. This explains why an anti-hunting device may in one case stop hunting; and the same, or similar device, in another case make hunting worse; if the increase of energy losses due to the device is greater than the increase of lag of the synchronizing force, it improves the operation; otherwise it makes hunting worse.

The foremost problem in the design of anti-hunting devices is to reduce to a minimum the lag of the synchronizing force caused by them. They usually operate by currents produced in them by e.m.f's. induced by the position oscillation. Since, owing to inductance, the currents lag behind the induced e.m.f's., this gives an unavoidable lag of the synchronizing force; and the more non-inductive the anti-hunting winding is made, the more effective it thus becomes. Therefore, while a conducting collar around the face of the pole close to the armature may stop hunting, the same short-circuit around the field pole at a distance from the armature may make hunting worse, owing to the greater self-inductive lag of the currents induced in it.

The Cause of Hunting

Hunting then is the phenomenon resulting from the lag of the synchronizing force behind its cause, the position displacement; and is a general phenomenon, which can be observed in all oscillatory phenomena where a lag of the effect occurs behind its cause.

Thus the vibration of a belt may become a mechanical hunting, increasing an amplitude until the belt is thrown off. The pulley is double cone shaped: so that the belt, when running towards one side, grips on one side of the cone, and therefore rolls up on the cone towards the middle of the pulley. There it runs over on the other side, grips there, and rolls back to the first side; and so see-saws between the two sides of the pulley. If now the conditions are such that the belt runs beyond the middle of the pulley, before it grips on the other side, it comes back with increased force, i.e., the vibration increases in amplitude, in true mechanical hunting. Here also the observation can often be made that the operation is steady at heavy load, where the energy losses (slippage and stretching of the belt in this case) dampen the hunting; while at light load the oscillations begin, just as is often observed in the case of synchronous machines.

One of the most important oscillations with which electrical engineering has to deal, is the electromagnetic oscillations of distributed capacity and inductance—electric waves, impulses and other transients. When dealing with such waves in overhead transmission lines below the corona voltage, i.e., in magnetic and dielectric fields which are proportional to the current and the voltage respectively, no hunting can occur. As soon, however, as this proportionately ceases, and a lag makes its appearance, such as the lag of the magnetic field behind the current in magnetic materials, the lag of the arc voltage behind the arc current, etc., true hunting may occur, if the energy dissipation (i.e., the ohmic resistance) is sufficiently low; and in such case, then, as oscillations in the high potential windings of alternating current transformers, in the phenomena of arcing grounds, etc., electromagnetic hunting—analogous to the electromechanical hunting of the synchronous machine—can occur and has been observed and studied.

Long Distance Telegraphing

As recently stated in the Electrical News, an invention has been perfected by Mr. Jno. Gott, of London, Eng., consulting engineer to the Commercial Cable Company, which in turn is controlled by the Mackay Companies, by which it was possible to telegraph between London, Eng., and San Francisco, and a few days later between London, Eng., and Vancouver, B.C., without the necessity of relaying. A brief description of the invention which has had such a revolutionizing effect on the transmission of long distance messages by telegraph is given herewith.

The purpose of the invention is to apply the international Morse code to the transmission of messages over long submarine cables, in place of the code now used, whereby uniformity of working with land lines and other connections may be established.

It is well known that reversed currents sent rapidly through a long submarine cable are the most effective in definition as received at the distant end of the cable—each following current having the effect of neutralizing the preceding one. In Mr. Gott's invention every unit of each letter is formed by a reversed current, so that in no case during transmission does a current of the same polarity follow.

At the receiving end of the cable these reversed units of letters are transformed in a simple manner so that the alphabet comes out in Morse characters as if received through a short land line and are therefore easy to read and transcribe.

To obtain the reversal of polarity for each unit of a letter with absolute uniformity and certainty Mr. Gott makes use of the discharge of current from the cable itself, which, having considerable energy, is able to act upon a polarized relay and cause the desired change of direction for the following signal. The direction of the discharge is a factor of the polarity of the charge, and changes in accordance therewith, so that the reversals produced by this action on the polarized relay follow in sequence with infallible regularity. Another method of effecting the reversal of the polarized relay consists of a transformer provided with primary and secondary coils, the primary being placed in the earth circuit of the split or double battery. Currents are induced in the secondary, which is connected to and actuates the polarized relay. The induced currents in the secondary coil are reversed according to the polarity of the last current sent into the cable and these reversals take place in regular sequence, assuring that no two successive currents are sent of the same polarity. One advantage of this last method is that on making contact with the key to charge the cable the battery contact in the relay is reinforced at the moment the key is depressed, thus assuring perfect transmission. This is brought about by the action of the secondary coil. The sending of messages through the cable is effected by the working of a single Morse key of the usual type so that the operaator's mode of manipulation is exactly the same as if he were sending into any ordinary line.

Where it is desired to send messages automatically the message is prepared on a perforated slip and the Wheatstone transmitter takes the place of the key, the reversing polarized relay being connected in circuit as for hand keying with the ordinary and well-known Wheatstone transmitter. The two upper contacts of the vibrating contact arm are used to take the place of the key. So also, where the system is

applied for translation from a land line or short connecting cable, the usual receiving relay is connected to the reversing polarized relay in the manner described for the hand key and the received Morse signals are translated into the cable in the form of a "reversed current alphabet" or alternating current alphabet devised by Mr. Gott. Also the relay referred to may work a sounder-relay in a local circuit, which being connected in place of the single Morse key, translates the signals for the short connecting lines or cables into the main cable.

It remains now to point out how the Morse code, which is sent through the cable in the form of reversals for each unit of a letter, is retransformed into the common Morse code. In all systems of relay repeaters on long cables hitherto used the contact arm when at rest occupies a neutral position (known as no man's land) between two contact plates which are connected to the local battery intended to actuate local instruments for repeating the signals either into another cable or to record the received signals. If we connect the two contact plates together it follows that the movable contact-making tongue will record signals made on either side, and these signals will appear on the local apparatus as if made continuously on one contact. For example, two reversals will appear as four dots (the letter "h" in Morse), and we shall have all the reversed signals received through the cable transformed into the well known Morse characters. These may be read by sound or printed on a Morse slip and similarly they may be repeated automatically to another distant station in the Morse characters. It follows from these observations that the cable relay, with its contact tongue and neutral center, will faithfully transmit the reversed Morse code into another cable in the form received, and that the

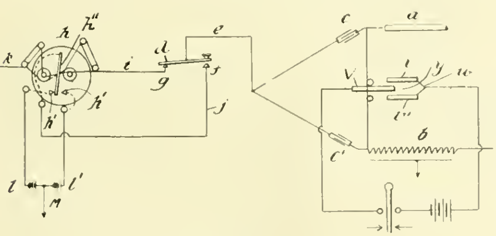


Fig. 1.

final transformation takes place at the terminal station of the main cables where the message is either transcribed for delivery or repeated inland.

In the diagram Fig. 1 a designates a cable; b the artificial cables used for duplex; c, c′ the sending condensers; e the wire connecting the key d to the apex of the bridge arms; f the front contact of the key; and g the back contact thereof. The front contact f is connected to the tongue or vibrating arm h″ of a polarized relay h by wire j; and the back contact is connected to the coils of the relay h by wire i. When the key is depressed the battery is connected to the cable, and when the key is open and in engagement with the back contact the cable discharges through the relay coils and to earth at k. To the two stops h′ h′ of the relay h are connected the opposite poles of a spilt battery l l′, the center part of battery being grounded at M. The tongue or vibrating arm h″ of the polarized relay is adapted, as is usual, to make contact with either of the stops h′ h′.

When the key d is depressed the battery l or l′ is connected to the cable through the wires j and e. When the key is opened the cable discharges through the polarized relay to earth and in doing so causes the tongue of the relay to be thrown to either contact h′ h′ according to the polarity of the discharge. As this polarity is always opposite to the polarity of the preceding discharge it is manifest that the tongue or arm h″ will be thrown from one contact h′ to the other at the end of each key operation, so that the battery to the line will be reversed each time the key is opened and the cable discharged. The result of this is that the current impulse sent to the line at each key operation will be opposite in polarity to the previously sent current impulse. It is therefore evident that in operating the key for sending Morse code signals each signal unit impulse will be opposite in polarity to the preceding signal unit impulse and no two succeeding signal unit impulses will be of the same polarity.

Owing to the considerable energy of the discharge from the cable and condensers (not heretofore utilized) the resist-

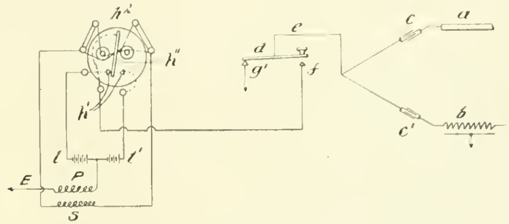


Fig. 2.

ance of the coils of the polarized relay may be negligible and still afford ample opportunity for the discharge to be effective for good signaling.

Referring to the construction diagrammatically illustrated in Fig. 2, the back contact g′ of the sending key d is connected to earth and the discharge from the cable and condensers is directed to earth through said contact when the key is open. The reversal of the polarized relay h^2 is brought about by the split battery making earth at E through the primary coil P of a transformer, the secondary coil S being connected to the relay coils. The opposite poles of the two portions of the split battery are connected to the contacts h′ h′ of the polarized relay in the same manner as shown in Fig. 1, and the front contact of the key is electrically connected to the movable tongue or vibrating arm h″ of the polarized relay. It is manifest that when the key is depressed a current will be induced in the secondary coil of the transformer, which current will firmly hold the tongue of the polarized relay against one of its stops. It is also evident that

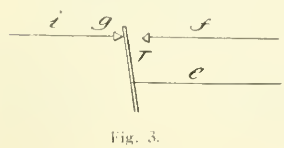


Fig. 3.

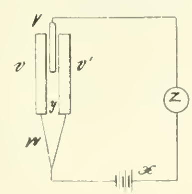


Fig. 4

when the key is opened a reversal of current in the secondary coil will take place and the vibrating tongue or arm will then be thrown against the other stop of the polarized relay, thereby reversing the polarity of the current to the front stop f, and consequently to the line, when the key is again depressed or closed. The same cycle of operations follows each depression and raising of the sending key.

Fig. 3 simply illustrates how the tongue T of a relay connected to a land line or short cable takes the place of the key either in Fig. 1 or Fig. 2. It also illustrates how the rocking contact bar of a Wheatstone transmitter is connected in place of the key to send automatically into the cable, the upper two contacts of the transmitter only being used.

Fig. 4 represents the apparatus used at the receiving or terminal end of the cable. The two metal plates v and v′ are

separated by an insulatoı y. The contact making tongue V is actuated by an attachment to the signal coil of a recorder, which coil is in circuit with the cable. Arriving signals move this tongue from zero to v or v' according to the polarity of the arriving current. For the purpose of this invention the two metal plates are conected together by the wires at W and are in circuit with the local battery x, etc. The instrument at Z may be a Morse recording instrument, a sounder or relay or other instrument. It will be clearly seen that rapid reversals will be indicated by the sounder, for example, as dots or dashes, as if made on one contact only, as in ordinary Morse working.

B. C. Electrical Development

The installation of a series tungsten lighting system, consisting of 225 lamps, was recently completed in the municipality of Oak Bay, adjoining the city of Victoria, and anticipations were more than realized by the success of the first test. The system is highly efficient, and can be added to from time to time as the development of the district warrants. Esquimalt municipality will not be long behind its older neighbor in the matter of a street lighting system, as it has now on order a similar installation with the B. C. Electric Company, which put in that of Oak Bay. The Esquimalt installation is a series tungsten system consisting of apparatus having a capacity of 275 80-watt lamps, of which 130 will be installed immediately, and the balance from time to time as required. Current will be supplied to both municipalities by the company. The work in Oak Bay district was under the direct supervision of Mr. S. J. Halls, manager of the light and power department of the B. C. E. R. Company, who will also give similar personal supervision to the system to be installed at Esquimalt.

Social Gatherings

The employees of the British Columbia Electric Railway Company take great interest in the development of the social side of the company life, the management of the concern asisting in this movement as it has been found that a social gathering of the staff works to the best interest of the company's service. During the past month the B. C. Electric Social Club held a ladies' night and conversazione in its Vancouver quarters. It was attended by over 200 members of the club and their lady friends. General manager Sperling and all the chief officials of the company were present and took an active part in the programme. At Victoria the office staff gave a dance at the Alexandra Club which was attended by over 200 members of the staff and their friends. In the Delta district the employees of the company organized and gave a dance at Ladner which was the chief social event of the season in the district. The management of the company is now paying attention to providing for the pleasure of its employees during the outdoor season. The company recently acquired 10 acres of land in the suburbs of Vancouver and plans to utilize this tract, for the present, as recreation grounds for its employees. During the present season one acre will be cleared and lawn tennis courts laid out, as well as a suitable club house erected.

Inspecting Coquitlam Work

Mr. J. R. Freeman, the engineer who is representing the Dominion Government in connection with the erection of the great dam at the outlet of Lake Coquitlam by the British Columbia Electric Railway Company, recently made an inspection of the work. While on the Pacific coast he addressed a public meeting at New Westminster concerning the dam. Press reports on this address quote Mr. Freeman as saying that Mr. G. R. G. Conway, chief engineer of the B. C. E. R. had co-operated with him concerning the construction of the dam in every possible way and, as a result, the dam would be one of the safest in the world. The water supply of New Westminster is taken from Lake Coquitlam and Mr. Freeman said that the provisions made by the company to preserve the purity of this supply entailed an expenditure of nearly $1,000,000, this amount covering clearing about the lake, erection of new water works intake, etc.

The great dam of the B. C. Electric at Lake Coquitlam will probably be completed in June, this being in advance of expectations. It will be 98 feet high, 600 feet wide at the base, 850 feet long and 40 feet wide on the crest. In the construction 1,055,000 cubic yards of material will be handled. The storage capacity of the dam will be 7,404,000,000 cubic feet, giving a reserve supply during the dry season of over 53,700,000 kw.h. of electric energy.

Will Erect Three More Barns

The British Columbia Electric Railway Company has announced plans for the erection of three car barns, these being extensions of its present buildings of the class in Vancouver, New Westminster and North Vancouver.

The Vancouver car barns will be 400 feet in length, 52 feet wide and accommodation for forty cars on the four tracks which will be provided. The location is along the Lulu Island Railway line and the barn will serve both its interurban division and several branches of the Vancouver city lines. Tracks will be laid from the Kitsilano line and also from the Fourth avenue line entering the barns from opposite sides. The building will have a concrete foundation and will be constructed of wooden frame covered with corrugated iron. At the present time a small barn is located at the point and is equipped with shops for emergency repairs. The company's plans call for a duplication of the new barn on a location immediately to the east, in the near future.

The new barns at New Westminster are located on 12th street and will be 240 by 104 feet in size. Eight tracks will be provided into these barns, which will accommodate both the cars of the New Westminster city line and the interurban branches of the company's service. This structure will also have a concrete foundation with building of corrugated iron.

The North Vancouver car barn will have a concrete foundation, steel frame and covered with corrugated iron. This barn will not be as large as the Vancouver or New Westminster barns, but will amply provide for the accommodation of the North Vancouver cars for some time to come.

Burnaby Grants Franchise

On April 26th the electors of Burnaby municipality granted the British Columbia Electric Railway Company a franchise covering tram transportation for a period of 36½ years. The vote on the measure was 713 for and 299 against, thus giving a good majority over the requisite three-fifths. The immediate demands of the franchise are that the company shall construct a line two miles in length on Hastings street east, this being an extension of its Vancouver line. Another line, one mile in length, is to be constructed on the North Road as soon as the arrangements are made for the high level bridge over the Brunette River, this line being an extension of the New Westminster lines of the company.

The B. C. E. R. Company has announced its intention of building a large repair shop on D.L. 118, Burnaby Municipality, just outside the city of Vancouver. The Westinghouse, Church, Kerr Company of New York, have been engaged as consulting engineers for this plant and their staff is now engaged in preparing plans. It is the company's intention to make these shops up-to-date in every particular, the idea being that this plant shall do all the heavier repair work for all lines operating on the southern mainland of British Columbia. The shops will be called the Horne-

Payne repair shops in honor of the chairman of the board of directors of the company, Mr. R. M. Horne-Payne.

The B. C. E. R. Company has offered to construct a four-mile line across West Vancouver municipality, this being an extension of the company's North Vancouver lines. West Vancouver was recently created as a separate district and the B. C. E. R. has rights in the section by reason of a franchise covering the old municipality at North Vancouver. As West Vancouver is but sparsely settled, the company's offer to build the line demands that a guarantee be given as to operating expenses other than interest on invested capital. The annual cost of operating an hourly service over the line is placed at $10,000 per year. The question is now under negotiation between the company and the municipal authorities.

The traffic department of the British Columbia Electric Railway Company has directed its conductors to strictly enforce its established rule with reference to the carriage of dags on the cars of the city lines. This rule provides that dogs will be carried on the cars only when in the lap or arms of the owner and then controlled so as not to annoy passengers. This rule has been in existence for some time but has not been strictly enforced. As a result, a dog fight took place in the aisle of a crowded car recently, the occupants becoming greatly frightened. The company considered the report of this instance in connection with other complaints concerning dogs soiling the clothing of passengers, etc., and decided that this rule should hereafter be strictly enforced.

New Type of Mine Trolley

As a result of the demand for a mine trolley differing from the standard lines, a new type, as shown in the accompanying illustrations, has recently been placed on the market by the Westinghouse Company. This particular trolley has several distinct advantages over existing types, three very important features being as follows:—

(1) The variation in contact pressure for different trolley wire heights is much less than that obtained by a standard single pole trolley.

(2) The short length of the trolley pole permits turning around in narrow passages.

(3) Trolley does not interfere with high trailing cars on sections where trolley wire is low.

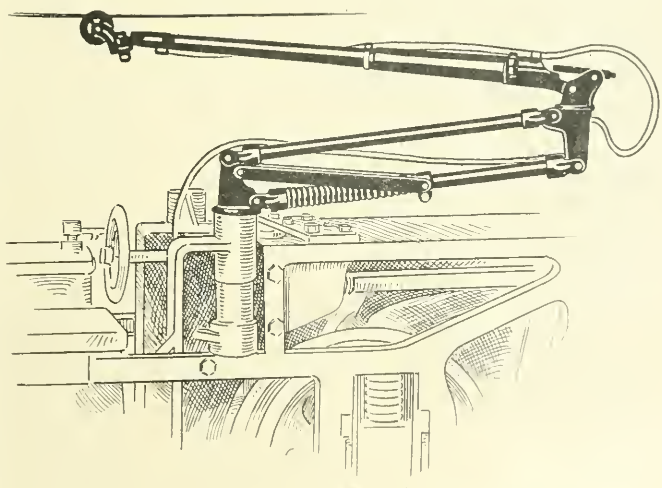
The design of the trolley is such that there is very little variation in the contact pressure when traversing sections of mines where the trolley wire is suspended at different heights. When the wire is at a height of five feet from the top of the rail, the trolley wheel pressure is approximately twenty-six pounds, while at a height of eleven feet it is about eighteen pounds. This shows a variation of eight pounds through a range of six feet, which is much less than can be obtained by a single pole trolley. With the standard single pole trolley, where the wire hangs low and extreme contact pressure is exerted, the pole is often damaged when the wheel leaves the wire and strikes a roof or other obstruction. The new type trolley under these conditions, owing to the slight variation in pressure throughout the wide range in height, will be less liable to danger of breakage. This slight variation also makes it unnecessary to resort to the heavy pressure for low trolley wires, with the result that the wear at the wheel and harp will be materially less than that caused by the single pole trolley.

In coal mines where the condition of the roof or overhanging rock is such that narrow entries are necessary, it is often impossible to run one of the longer single pole trolleys; whereas this new type trolley can be turned around in passages from four to six feet in width, with the socket located approximately in the center of the locomotive.

Where fairly high cars are used and a wide variation in the height of the trolley wire occurs, trouble is often encountered with the single pole trolley striking the car when the trolley wire is low, owing to the projection of the wheel over the car. The new trolley is designed especially to overcome this objection, as the entire operation of the trolley can be kept within a radius of four to six feet from the vertical line through the trolley socket. If the trolley wire changes in height and position over the track during the run, as is often the case on surface haulage, particularly in iron and copper mines, the trolley wheel can be made to follow the wire throughout a six-foot vertical change and a wide horizontal range without stopping the locomotive.

When the locomotive is used for gathering purposes, and where two single pole trolleys are ordinarily required, one on each side of the locomotive, this trolley can be used with the trolley socket located near the center of the locomotive toward the front end; the upper pole can be swung to operate satisfactorily on either side of the locomotive, whether the trolley wire be on the crosscut side of the entry or on the room side.

The trolley is designed to operate on a wire having a range in height of from 5 to 11 feet above the top of the rail; it being assumed that the locomotive trolley socket is about three feet above the rail. The trolley will operate successfully where the trolley wire may have a variation in its location from the center of the track on which the locomotive is running to 4 feet to the right or left, without change of location on the locomotive itself.



New type of Mine Trolley

The trolley consists of two members which operate in sockets. By means of a latch or pin at the lower socket, the lower member can be adjusted vertically and kept in a rigid position, and further, can be swung horizontally and fastened in any definite position required. Further, it can be used on locomotives now in service.

Adding Profitable Summer Load

The growth of the central station industry resulting from the employment of more scientific methods of management has been to a very large extent due to the attention that is now given to the improvement of the load-factors. Many central station managers who do not keep actual figures of the operation of their power plant would be surprised at the exceedingly small percentage their actual receipts are of the total receipts their plant might bring in if they were operating at full capacity. In many cases this is less than 25 per cent. and often gets down to 10 or even 5 per cent.

It is only the exceptional station that is so fortunately situated as to have a large proportion of its output used for power purposes, which results in a comparatively high load-factor, but in the average station where current is used largely for residence and commercial lighting, conditions are quite otherwise. Of the two lighting loads mentioned residence lighting generally has a better load-factor than commercial lighting alone, since offices and stores in general use current for a shorter period each day than do the residences. It therefore becomes the necessary duty of all central station managers to be on the look out for new methods by which the excess capacity of their plants can be put to a revenue producing use. In almost every case where the load can be increased the income is clear profit from the fact that this extra load can be taken care of without additional equipment or additional expense of any kind.

These remarks are specially applicable during the spring and summer months when the lighting load is much smaller and it is fortunate that this is the time of year at which many current consuming devices now on the market, are easy of introduction into the consumers' homes. There are a number of useful and popular, and indeed almost necessary devices, which on account of their convenience and economy of operation, consuming only a small amount of current, can be disposed of to the average consumer with comparative ease and are a decided factor in the revenue producing characteristics of any central station plant. These include the electric washer, vacuum cleaners of many sorts, motor-driven sewing machines, ironing machines, pumps, vibrators, polishers, percolators, toasters, water heaters, etc. A small general utility motor can often be installed for the consumer in his work-shop or for different purposes in the garage. Some of these articles have been considered luxuries, but in the present age any luxury which adds to a consumer's capacity for enjoyment or permits him to spend his hours of recreation in such a way that he is better fitted for his day's work, can no longer be considered anything but a necessity.

Electric Iron Comes First

As a revenue producer as well as a work saver the electric iron probably takes first place, the low first cost making it somewhat easier to introduce into the home. Since it is rugged in construction it can be placed on trial without fear of damage, and having once been installed it is a rare case that these are thrown back on the hands of the dealer. In many families, during the summer months at least, there is more current used for ironing than for lighting. Even in the smaller municipalities where the plant may not be operating throughout the day, the added convenience of the electric iron may easily be shown to be sufficient to justify householders in doing their ironing during the early evening hours when the current is first turned on. Or an arrangement might be made with the users of electric irons that the current be turned on for a certain definite period once or twice a week during part of the day, such as Tuesday morning from 9 to 11.

In the introduction of current consuming devices at this season of the year special stress should be laid, of course, upon those articles which are conducive to the comfort and convenience of the consumer in hot weather. Aside from electric irons, fans and ventilating apparatus will quickly arouse the interest of the average housewife or office man. Here again as fans are of rugged construction these may be put in on approbation and with a temperature ranging anywhere between 85 and 105 it is pretty safe to conclude that the average householder or office man will think twice before he sees his cooling devices removed. It is not only the comfort of the electric fan but, even more than this, the sanitary conditions surrounding its use which make it possible for those who come under its influence to do more and better work in the same time. Of course, electric fans cannot be sold in cold weather and the manager should be ready for the first oppressively hot day and should reap his harvest before it is over-ripe.

And here too it may be well to note again that a satisfied customer is often the best salesman a dealer can have. By making an occasional inspection of the electrical equipment installed or by, each season, taking the precaution of having the irons, fan motors or other equipment overhauled, satisfied, enthusiastic users are the result, at small expense to the dealer.

The Electric Cooker

Another line of domestic equipment which is coming rapidly into use and for which there is undoubtedly a very large field is the electric fireless cooker. Electric cooking in the past, while of admitted convenience has scarcely been attempted in competition with coal or gas on a basis of dollars or cents, but at the present time there is more than one make of apparatus which, in addition to the comfort and convenience resulting from its use can, under average conditions of current cost, compete in operating cost with coal or gas. This is partly the result of increased efficiency in the manufacture of the apparatus itself but it has also come about in part by the reduced cost of current now obtaining at many points throughout the Dominion, as well as by the introduction of a well-nigh perfect control which guarantees against the use of any unnecessary current. In addition the quality of the product of the electric stove seems to more than hold its own with that of the coal stove or the gas range. This will be a strong argument with the user after he has once become accustomed to the use of the electric cooker. Electric cookers further, especially the fireless variety, develop practically no heat in the room and so are specially appreciated in hot weather.

Among the other summer loads which may be developed under certain conditions is that of lighting amusement places or the operation of amusement equipment by motor drive, the supply of current to buildings that have isolated plants operated by exhaust steam during the winter, but which cannot operate economically during the summer. Another load which might be developed in many towns is that of refrigerating apparatus. At the present time there is on the market an efficient household refrigerating equipment driven by a small motor. This motor circulates brine around the refrigerator which has been cooled by the ammonia process. Its operation is exceedingly simple and efficient and the initial cost not great. The charging of storage batteries is also a useful type of load and should be developed as far as possible, as the use of the battery can be made much more general than it is at present.

Renfrew Electric Manufacturing Company, Limited, has been incorporated with a capital stock of $50,000 to manufacture and deal in electrical machinery, appliances, etc., with head office at Renfrew.

Important Problems in Telephone Work

Electrical Interference Between High Tension Circuits and Telephone Circuits— The Remedy in Theory and Practice (Con. from April 15)

By Mr. C. A. Buckard

The first half of this article dealt with the theory underlying the interference between high tension currents and telephone lines and we will now consider the application of this theory.

While theoretically application as shown in the discussion thus far the telephone circuit can be operated in the vicinity of a high tension circuit the actual application of any method and especially the use of transpositions is complicated by conditions in the telephone plant itself. Where more than one telephone circuit is in parallel proximity to other telephone circuits on the same route, they react inductively on each other producing what is known as crosstalk or overhearing. To overcome this the telephone company have adopted systems of so-called crosstalk transpositions. For ordinary physical circuits the system shown in Fig. 4 is sometimes used.

Among the ingenious circuit schemes which have been developed in telephone work is the circuit known as a phantom. This really is, however, a true physical circuit, the general idea being given as follows: By a combination of repeating coils, i.e., transformers, it is possible to have three

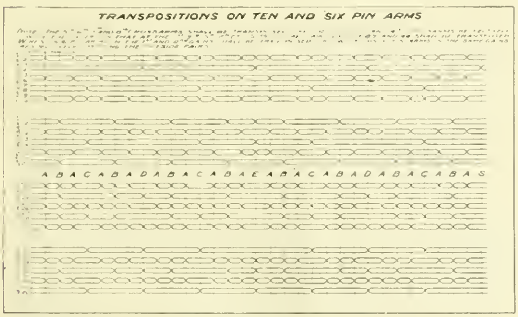


Fig. 4

independent telephone circuits on four wires, the scheme of the circuit being shown in Fig 5. This circuit being a true physical circuit it becomes necessary to transpose this against other similar phantom circuits, against the physical circuits of which it is made up and against other physical circuits all on the same route or pole lead. Systems of transposition to do this have been developed such that the so-called phantom transpositions are superimposed on the system of physical transpositions as given in Fig. 4, and fulfill all the requirements in a very satisfactory manner.

If transpositions in the telephone circuits against high tension systems are to be introduced they should not unbalance the crosstalk transposition system. Just how this is done can best be described by taking up typical cases and how they are treated.

When trouble in a telephone line due to an exposure with a high tension circuit is reported the following information is obtained:—

1. Pole diagram of every telephone pole, such diagram to include.
   - (a) Type of crossarm used;
   - (b) Total number of telephone wires including gauge and pin position;
   - (c) Loading coils, crosstalk transpositions, cable terminals, loops to offices or subscribers.

2. Pole diagram of every pole carrying the disturbing wires, such diagram to include.—
   - (a) Type of crossarm;
   - (b) Total number of wires, type of circuits, arc lights or transformer primaries, etc., and the pin position of the wires of each circuit;
   - (c) Transformers, loops from main line, street arc lamps, etc.

3. In cases of underbuilding or overbuilding or joint

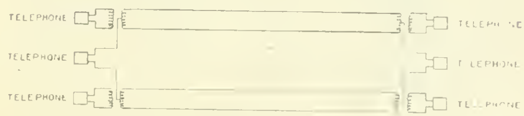


Fig. 5

line construction the vertical separation of the various crossarms carrying the wires of each line.

4. In paralleling lines separated by the width of a street the centre to centre separation of the poles of the two lines.

In Fig. 6 appear pole diagrams which represent the results as would appear in the field book upon completion of a length of line subject to high tension exposure.

From data obtained from the inspection as above outlined the results would be charted similarly to Fig. 7.

On this diagram will be seen, first, the separation of the nearest crossarm of the two lines, pole numbers, location and type of transposition poles, etc., and second, the horizontal spacing of wires of the disturbing circuits; type of crossarm, transformers, arc lamps, etc.

Fig. 6

During the inspection as above outlined particular attention is paid to line insulation conditions and all causes of low insulation or insulation unbalance removed from the telephone circuits. This is a primary consideration in all studies of noisy telephone circuits subject to inductive exposure

Resistance unbalance is noted, and steps taken towards its removal. Photographs of exposures are obtained and attached to the report.

In Fig. 8 we have a chart as actually made up for an exposure between a telephone circuit and an a.c. series arc light circuit.

The series arc light circuit is operated from a tub transformer carrying a load of about 50 arc lights. In this arc light circuit no attempt is made to keep the two sides of the

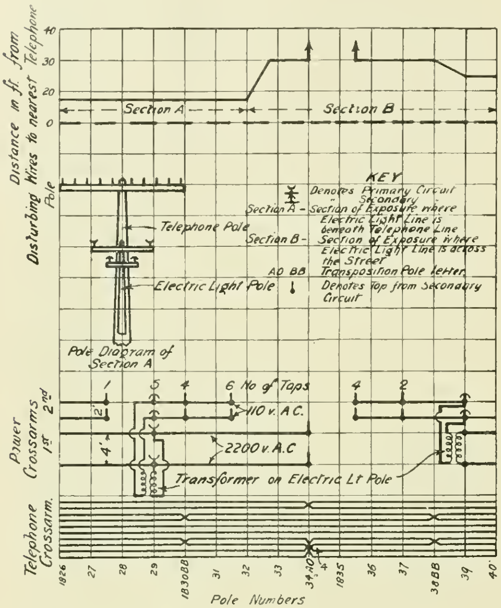


Fig. 7

circuit together, but one wire circulates over different streets of the town with arc lamps cut in at suitable points for lighting the streets. This way of running the a.c. circuit is probably one of the worst that the telephone companies have to contend with. The series arc light circuit is on the same poles with the telephone wires and with 5½ feet separation.

On the chart the location of the poles is to scale, each large division horizontally being 200 feet. The crosstalk transpositions are shown on the poles designated by a hollow circle. In order to get the best mutual electrostatic and electromagnetic balance between the power circuit and the telephone circuit it is necessary to have the crosstalk transposition points, neutral points in the scheme of transpositions against the a.c. series arc circuit, that is to say, points where the introduction of a transposition would not affect the balance against the power systems. How well this was accomplished in the scheme adopted is shown in the plot at the bottom of Fig. 8.

The abscissae here represent distance, one large division being 200 feet and the ordinates represent intensity of exposure, one large division representing the exposure of 200 feet of phantom circuit. Where a transposition is cut in, the direction of the induced current would be reversed, therefore we can say the direction of the exposure is reversed, which accounts for the see-saw appearance of the chart.

The design of the transposition scheme against the power circuit is such that the exposure chart comes out at zero value. This means that electromagnetic induction is entirely taken care of and the current due to electrostatic induction is only that due to about 100 to 120 feet exposure. In the case shown it was possible to neutralize the electromagnetic induction entirely but this would not have been true if it had not been a constant current system. The transposition scheme adopted against the power circuit is shown by following through the transposition designated by a cross circumscribed by a circle. In order to disturb the crosstalk balance as little as possible every circuit is transposed. Thus the crosstalk balance of the physical circuits is absolutely maintained and that of the phantom circuit is only slightly unbalanced.

A portion of the field notes of another exposure are shown in Fig. 7.

The power system was a three-wire two-phase system with the primary divided and one-phase running down different streets on one of which the exposure occurs. The spacing between the primary wires in this portion was four feet straddling the pole.

There was low unbalance insulation in the primary wires and the load was also badly unbalanced as indicated by transformers and transformer capacities, the whole resulting in what appeared to be a strong electrostatic field. The telephone wires were from ten to twenty feet away. The potential in each phase of the power circuit was 2200 volts. Normally such a potential with a separation of ten or twenty feet should not give trouble.

From the field notes the chart in Fig. 9 was made up. A study of the chart showed that owing to the character of the load it was impossible to neutralize both electrostatic and electromagnetic induction. As electrostatic induction appeared to predominate it was decided to transpose mainly for that. The transposition scheme adopted is that shown at points with designation by a cross circumscribed with a circle. The intensity of electrostatic exposure is shown in the dot and dash line which comes out at zero.

By obtaining values of current strength in different portions of the power circuit it was possible to plot the intensity of the electromagnetic exposure. This is shown by the

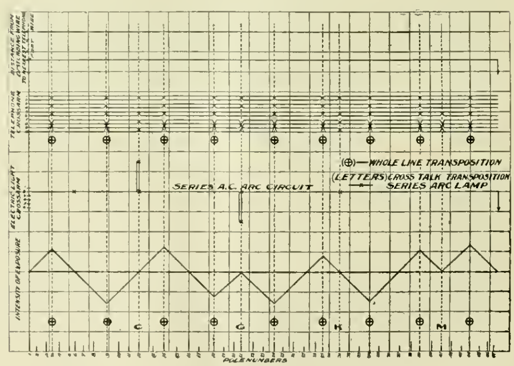


Fig. 8

solid line. The scale of this has no relation with that of the electrostatic induction and probably the total effect was very much smaller.

The load in the power circuit reduced in a direction opposite to that in which the telephone line was transposed, therefore, for convenience the intensity of electromagnetic exposure is plotted from right to left. It will be noted reading from right to left that this comes out with a very small value as compared with maximum condition. Actual tests

made after the installation of this transposition scheme verified the correctness of this work.

That the increasing congestion of high tension and telephone lines is a stern reality, is shown in Fig. 10. In this

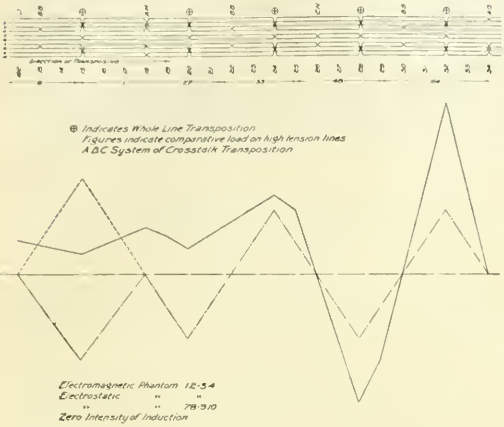


Fig. 9

picture the line to the extreme right is a 13200 volt, 3-phase transmission line operating with star connected transformers. Between it and the telephone line is a private telephone line of a 110,000 volt transmission system. The 110,000 volt line is on a right-of-way entirely apart. To the extreme left is a rural telephone line. Next to this is a 60,000 volt, 3-phase transmission line operating with open delta connected transformers. Between the telephone line and 60,000 volt transmission line are the towers of a new 85,000 volt transmission line. In this instance there will be operating three high tension systems and two telephone systems in a right of way about 150 feet wide. It is needless to say that the four arm telephone line was the first occupant of this right-of-way.

From the foregoing article it can be clearly seen that telephone companies are put to considerable expense and inconvenience to remedy troubles which are brought upon

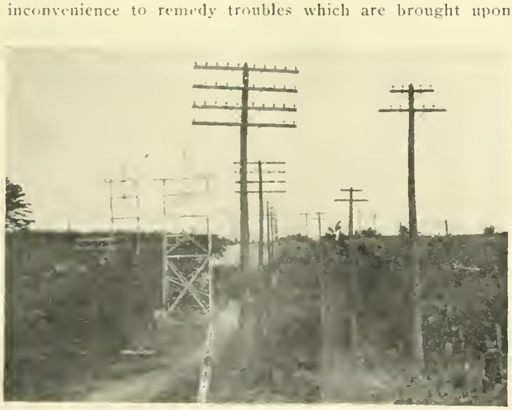


Fig. 10

them by parallelism with high potential power circuits. The best solution of this problem is to keep the conflicting systems as far apart as possible. Where close parallelism is unavoidable some rule for minimum distance for separation ought to be developed depending on the electrical conditions involved. In this connection the following quotation is of interest:—

"We know that electric power circuits may, and occasionally do, interfere with their weaker brothers, the telegraph and the telephone systems. The problem before us now—which is not a problem of interest only to the power engineer or the railway man or the telegraph engineer, but one of great importance to the electrical engineering profession at large—cannot be solved by saying that we are power engineers and expect the telegraph and telephone systems to take care of themselves. This would be as unfair and untenable as it would be for the telepgraph or telephone engineers to say; we were the first ones in the field and must not be interfered with, and we insist that the electric power systems shall be installed in such a manner as not to interfere with us."

This quotation is from Dr. Steinmetz in a discussion of inductive disturbance before the American Institute of Electrical Engineers.

Vancouver Increasing Facilities

Demands upon the telephone system of Vancouver are indicated by the increased facilities being made at Seymour, Fairmont, Bayview and Highland exchanges for handling daily traffic. This applies not only to traffic in and out of these exchanges, but also to inter-office business, which is constantly expanding.

At Seymour, in addition to the sections of "A" board now being put in place, six switching trunks from L. D. are to be installed, which will give a capacity of thirty-six trunks. A large toll business is done to and from Seymour, and it has been found that the thirty switching trunks now carrying the load are not sufficient. Inter-office trunks out of Seymour are also being increased in number, eight being installed to Bayview, which will give a total to this exchange of sixty-six.

Considerable additions are also being made to Bayview. Eight more trunks are being added from Seymour to Bayview, this number having been found necessary to take care of the increasing traffic between downtown and that portion of the city west of Willow street, which includes West Fairview and Shaughnessy Heights. Five more trunks are being connected to Fairmont. Bayview has also had twenty local trunks installed, giving it a capacity of sixty. It is expected with these additional facilities to meet the demand now existing.

The same conditions apply to Fairmont. Here, too, twenty local trunks are being installed, and in this instance also the total capacity for traffic in that part of Vancouver will be sixty trunks.

In New Westminster the capacity for recording toll traffic is being doubled. A one-line position has been used there, but a separate two-position recording board is being installed to take care of the long distance calls from New Westminster subscribers.

Highland is to have twelve additional inter-office trunks and four more long distance trunks.

In the two-number district, adjacent to Vancouver, expansion is steady. Five more trunks are being put in between Seymour and Collingwood; ten more to Eburne, and ten additional between Fraser and Vancouver.

Practically all the work has been done for installing a telephone despatching system on the Toronto, Hamilton and Buffalo Railway, a subsidiary of the C. P. R. Most of the western lines of the C. P. R. are now operated by telephone.

Cable Under Saanich Inlet

Shipment has been made of the cable which will be laid under Saanich Inlet, giving connection to the two land sections of the new line between Nanaimo and Victoria, which will complete the circuit between Vancouver and the Capital City, when the big cable is laid in June. The cable, which consists of 14,000 feet of ten-pair thirteen-gauge wire, was manufactured by the British Insulated and Helsby Company, of Prescott, Lancashire, England. It will be brought overland from the Atlantic coast, so that it can be put in place and be in readiness before the cable is laid across the Gulf of Georgia.

Extensions in Point Grey

The B. C. Telephone Company recently completed the estimate which covers extensions to the system in the Eburne and Kerrisdale section, Point Grey. So rapidly has this residential district forged ahead within the last two years that the company regard it as a suburb where development has to be anticipated.

The seven hundred poles necessary for construction of the aerial lines were in place by the first of April, and stringing of the cable is now being done. There will be about ten miles of cable altogether, made up as follows: 11,700 feet of 400-pair; 4,000 feet of 300-pair; 8,000 feet of 200-pair; 2,000 feet of 150-pair; 10,000 feet of 100-pair; 9,000 feet of 50-pair, and 6,000 feet of 25-pair.

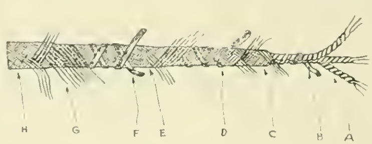
In conjunction with this construction might be taken the West Bayview estimate, which will take in the territory from Yew street west to Blanca Drive in Point Grey. Along with this will be the land line of the new cable across the Gulf, and by July 1st it is expected that the company will be in a position to supply service to every resident of Point Grey peninsula. These estimates will not only supply relief to sections at present congested, but will furnish facilities for service where none now exist.

The Switchboard Cord

The switchboard cord, so often carelessly handled, seems at first sight to be a very simple affair, whereas a closer glance will reveal it to be very intricate.

On account of their being constantly in use, the delicate wires inside are easily damaged or broken, and the majority of telephone apparatus manufacturers agree that the cords are one of the most difficult parts of the switchboard to turn out satisfactorily.

The attached sketch will give some idea of the interior of the cord. The core (a) is formed of linen twine upon



Switchboard Cord

which is wound the first, or tip (b) conductor of flat steel wire. Over this are placed three layers of insulation consisting of two wrappings of silk and a braiding of linen (c). The second or ring conductor (d) is of flat steel wire also, but it wound on the core thus formed in a direction opposite to the first conductor. Two wrappings of silk are next placed over the entire length of the core (d) and then a braiding of linen (e). Over these are wound two separate conductors, one of coppor ribbon and the other of flat steel wire, which forms the third or sleeve conductor (f). Over these are placed two wrappings of silk (g) and over the silk for a distance of 16 inches at the plug end of the cord there is placed a braiding of cotton (h). The whole is then covered with a braiding of glazed cotton, having an additional braiding for about twelve inches at the plug end to reinforce that part of the cord subjected to the most severe usage.

It will thus be seen that the switchboard cords are very easily damaged and a knowledge of their construction will enable those who handle them to appreciate the advantage of using them carefully.

New Telegraph Lines

New telegraph lines are provided for in British Columbia as follows:

Alberni-Clayoquot telegraph line—for telegraph and telephone extensions beyond Clayoquot to Estevan Point, and Friendly Cove, $23,200.

Queen Charlotte Islands—Telegraph line beyond Dead Tree Point to Masset, $13,750.

Vancouver-Powell River telegraph line—Construction of branch line from Point Atkinson to Newport along Montague Channel, $8,500.

Personals

Mr. J. Antonisen, city engineer of Moose Jaw, has been appointed superintendent of the Brandon municipal street railway system.

Mr. H. H. Cousens, the newly-appointed general manager or the Toronto Hydro-electric System, sailed for Canada May 13 by S.S. "Megantic."

Mr. J. D. Evans, former chief engineer of the Montreal Tramways Company, was recently elected a member of the American Society of Civil Engineers.

Mr. W. R. Sweany, formerly acting manager of the Toronto hydro-electric system has been appointed general sales manager of the Toronto Electric Light Company.

Mr. R. T. Morris, municipal electrician of South Vancouver has resigned to associate himself with Mr. G. M. Gest, the well-known conduit engineer and contractor.

Mr. Howard Murray, treasurer of the Shawinigan Water and Power Company, Montreal, has been nominated as the new president of the Montreal branch of the Canadian Manufacturers' Assocaition.

Mr. F. W. Caldwell has been appointed superintendent of the Edmonton municipal telephone system. Mr. Caldwell comes from Spokane where he has been superintendent of the home telephone company. It is understood he will retain both positions.

Mr. W. G. Murrin has been appointed mechanical superintendent of the British Columbia Electric Railway and recently assumed the duties of the position. Mr. Murrin comes from London, England, where he was connected in an executive capacity with the staff of the London United Railway.

Mr. D. R. Kennedy, electrical superintendent of the British Columbia Electric Railway has resigned his position and Mr. W. H. Fraser who has been connected with the electrical staff of the company, has been appointed in his place. Mr. Kennedy will spend the next few months travelling through the United States and the Dominion, inspecting various electrical plants.

Mr. E. E. F. Creighton, consulting engineer to the General Electric Company, Schenectady, delivered an address on April 25th before the Toronto section of the A.I.E.E. The address dealt with electrical disturbances on high tension lines and was particularly devoted to the explanation of the phenomena of high tension surges. Some exceedingly interesting experiments were shown in corrobation of the theory advanced by Mr. Creighton.

Electric Railways

Greater Toronto's Railway System — Trackage to be doubled in five years—Subways a last resort

A report on the transportation situation, present and future in Toronto, has just been presented to council by Mr. Bion J. Arnold, consulting engineer, of New York, with whom was associated Mr. John W. Moyes, of Toronto. The report deals with the present congestion and outlines at considerable length two alternative solutions. The first of these is based on the immediate purchase of the Toronto Railway Company's system, to which additions would be made during the next five years, costing in the neighborhood of $8,700,000. The other alternative is to build a double track subway from St. Clair avenue to Queen street, with auxiliary surface lines covering the suburban areas, including the recently annexed sections of the city or immediately outside of these. The latter would cost about $10,500,000.

The report states that Toronto has outgrown its transportation facilities and is in need of immediate relief. At the same time it appears that few difficulties stand in the way of a larger transportation expansion. If it were possible to face these difficulties through co-operation of the different interests involved, relief could be acquired quickly, but failing this, the alternative plan of a subway is suggested. In many respects the conditions covering the traction situation in Toronto are better than in other cities, particularly because of the favorable location of its business centre and its geographical surroundings, and especially so because the earning capacity of its transportation system has been so developed that any reasonable improvements may be put into effect without any general disturbance of either the financial or operating conditions of the company.

In some respects the service in Toronto is better than in many other cities. Car congestion could be remedied by the re-routing of a few lines in the congested district, and over-crowding at certain periods could be largely eliminated by the addition of a few cars on the trunk line. Revised schedules based on faster operation would greatly improve the service even without the addition of any more rolling stock. This may be greatly aided by a more careful training, tending to produce alertness on the part of the conductors and motormen, and thereby inducing more activity on the part of the public when boarding and alighting from cars.

Cross-town lines in certain sections are needed and extensions to existing lines should be built into outlying territory not only for the accommodation of those who are already there, but for the purpose of developing the unsettled districts not far from the business centre.

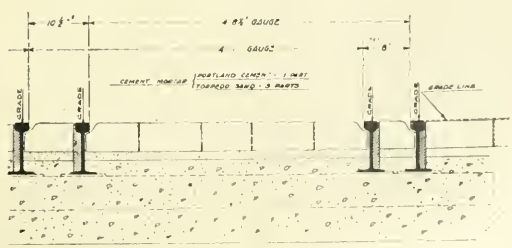
With the transportation affairs of the city under unified management subways would not be warranted. Yonge street, the present point of congestion, is not now carrying all the cars it could, and other streets such as Church, Victoria and Bay could accommodate several times the number now using them. Subways should be looked upon in the nature of a last resort. Toronto does not at present need subways nearly so much as it needs more surface tracks and more and better and faster surface cars, preferably under unified management.

Since 1907 the population of Toronto has increased at an average of nine per cent. per year. During that period car track mileage has increased only 2.4 per cent. per year. The number of car miles operated has increased during the last two years at the rate of 2.25 per cent. per year. During the period 1907 to 1911 inclusive, the gross income of the company increased at an average of 9.6 per cent. per year, showing a large and constant increase in receipts without a corresponding increase in service rendered.

The Toronto system earned $4,851,541 in 1911 and, assuming this rate to be maintained, the earnings in 1921 will be approximately $14,000,000. At the present time over $12 per capita per annum is being used for street car transportation in the city of Toronto.

The rolling stock consists of a mixture of large and small motor cars and trailers. The trailers should be retired and the single truck cars provided with truck guards and placed on cross town lines or on streets where the travel is light. Modern practice unmistakably points to the acceptance of the prepayment type of car for city service. In this type of car the platforms are of ample dimensions and so arranged as to separate incoming and outgoing passengers, thus facilitating the loading and unloading of passengers.

Recent track and road bed construction in Toronto is along modern lines except for the use of the local wide gauge. This should be standardized under any general reconstruction of the system and about 35 per cent. of present track rebuilt in the next five years. Car stations should be of fire-proof construction and divided into sections so that no more than 25 or 30 cars would be subject to fire loss at one time.



Arrangement for tracks of different gauge.

The power for the supervision of the maintenance of the physical property as well as its operation should be vested in a provincial or a municipal board clear of political bias and of unquestioned integrity and professional skill.

This board should be empowered by legislation to fully enforce its mandates.

Present Traffic Conditions

Under the above heading the report publishes some interesting figures of existing conditions in Toronto. The Toronto Railway Company is at present operating 113 miles of single track, 4 ft. 11 in. gauge, over an area approximating $10\frac{1}{4}$ miles in length east and west, by $3\frac{3}{4}$ miles in extreme width north and south. The number of cars in operation is 642, consisting of 569 double truck and single truck cars and 73 trailers. With this equipment the company in 1911 carried 121,000,000 cash and 49,000,000 transfer passengers. The gross receipts were $4,851,541.

To handle the same amount of business it is stated that other cities are provided with more cars and more tracks, the average of nine United States cities being about one car for each 500 of population and one mile of track for each 1,800 of population and one mile of track for every $23,000 of receipts. A comparison is made between Toronto and eight other cities showing the relative number of miles of track, populations, gross receipts, miles of track per thousand inhabitants, receipts per capita, receipts per mile of track and population per mile of track. These figures are reproduced herewith in an accompanying table from which it will be seen that Toronto is by far the highest in receipts and population per mile of track, but is lowest in trackage for each thousand inhabitants and is slightly below the average in receipts per capita.

Track Extensions

The track extensions are distributed over the years 1913, 1914, 1915, 1916 and 1917, the amount to be laid each year being approximately constant. By the latter date the mileage of greater Toronto would be increased from the present 113 miles to a total of 240, an addition of 127. This is divided approximately into 32 miles of single track in the old city limits of 1891; 10 miles in the territory annexed since that date; 28 miles of radial lines to be added to the city system; 40 miles in the territory outside the present city limits; and 17 miles now being built by the city. It is estimated that the construction of these extensions would cost approximately $2,617,427. This would include new lines to be built, civic lines now being constructed but not in operation, improvements to radials as outlined, crossings and other subway work, electrical overhead control wire and feeder cable with necessary poles, the city furnishing the roadbed and pavement.

For any but the streets of heaviest traffic the use of T-rail is recommended. For the heavy traffic district the groove rail should he used. Where the T-rail is used, however, and the street is paved, and if granite block is used for pavement, the blocks in contact with the rail should be uniformly cut so as to form a groove for the flange of the wheels. Where brick is used those in contact with the rail should be specially moulded to accomplish the same purpose.

Curves should be built so that cars can pass without interference. Frequently this will require the rounding off of a few feet on the corner sidewalk. The car movement in Toronto at several of the congested points would be materially aided and the average speed of the cars increased, without increasing their maximum speed, by the substitution of this class of special work for the present narrow centre work.

It is estimated that the system outlined will require 1,100 cars for the transportation of a population of 718,000 in 1921. With 500 of the present cars retained in service on light lines of travel, or rebuilt, there will be required 150 new cars to replace trailers and the poorer class of single truck motors. As fast as new lines are added to the system and population increases, new cars will be needed, the estimate being 250 at the end of five years. The rest of the final requirements should be placed in service at the rate of 50 per year.

Cost and Returns

The total cost of the proposed additions of 127 miles of new track, 600 modern prepayment cars, additional car houses, substations and other necessary equipment would be in the neighborhood of $8,762,000. An additional expense would be incurred if it were decided to place the electrical feeder and return cables underground. Under Toronto conditions the cost of these ought not to exceed the following: manholes $98 each; iron pipe laterals, 60c per foot; conduits, 41.6c for two ducts to 10.17c for 48 ducts, per duct foot. The total cost of improvements as mentioned above is divided approximately as follows:

Cost of Improvements

Track construction, 127 miles of single track (3.5 miles grooved rail; 123.5 miles "T" rail)... ..	$2,127,000
Overhead wires, poles and cables	489,000
Car-houses	820,000
Cars	4,500,000
Power stations and equipment	726,000
Miscellaneous equipment (work cars, snow and ice machinery, line wagons, sprinklers, etc.)	100,000
Total	$8,762,000

Presuming the completion of the above additions by the close of 1917 the financial showing for the year 1918 for the entire system of 240 miles of track is estimated as follows:

Gross earnings	$10,800,000
Operating expenses, taxes, renewals, pavement charges, etc., at 70 per cent.	7,560,000
Net earnings	3,240,000

The above estimate is considered very conservative for the following reasons: (1) The earnings are based upon the present riding habit, which averages $12.40 for the city, as it is now covered by the present limited traction lines. Were the complete system considered by this report to be now in operation, there would unquestionably result a higher earning per capita than $12.40, which projected into the future, upon the proper law of increase, would result in gross earnings in excess of the above named figure. (2) Owing to the

TABLE COMPARING TORONTO WITH OTHER CITIES.

City	Miles of Track	Population	Receipts	Miles Track per 1,000 persons	Receipts per capita	Receipts per mile of track	Population per mile track
Washington	217	331,000	$6,349,000	.656	$19.18	$29,258	1,525
New Orleans	200	339,000	4,206,000	.590	12.41	21,030	1,695
Baltimore	400	559,000	7,687,000	.716	13.75	19,220	1,397
Cincinnati.	222	364,000	5,005,000	.610	13.72	22,540	1,640
Cleveland	245	560,000	6,123,000	.437	10.93	24,990	2,286
Toledo	116	168,000	2,000,000	.690	11.90	17,241	1,448
Seattle	188	237,000	3,660,000	.790	15.44	19,470	1,261
Milwaukee	145	374,000	3,787,000	.388	10.13	26,114	2,579
Toronto, 1911	113	390,000	4,851,000	.289	12.44	42,929	3,451

Surface Electric Railway System of Greater Toronto. Circles represent half mile distances with centre at City Hall.

possibility of very cheap power being available for the operation of the entire system, an operating ratio as high as 70 per cent. is probably the maximum that would be encountered (including pavement charges). With such power supply the actual operating ratio will probably be in the neighborhood of 65 per cent. (exclusive of pavement charges). Thus, the estimate as based on minimum earnings and maximum operating ratio, necessarily gives the minimum net earnings that would be expected. This amount, $3,420,000, capitalized at 5 per cent., would support an investment of $64,800,000. or capitalized at 8 per cent., approximately $40,000,000. These figures may be assumed correct on the theory of a continuing investment on the part of the municipality or a company, but they should be reduced by whatever amount is found necessary to amortize the investment within the franchise life if the property is developed and operated by a company under a franchise for a fixed period.

The Alternative

On the supposition that the Toronto Railway Company's system is not bought out and that the two systems are operated independently for the next nine years, the only alternative seems to be a subway system with a terminal in the centre of the city, as it is understood the city is in a position where it cannot operate on the level owing to rights held by the Toronto Railway Company. Subways have their uses in congested areas where surface terminals are insufficient for traffic needs and where elevated structures would be objectionable. For the support of subways there should be densely populated districts some distance from the business centre seeking rapid transit which other means of transportation are unable to provide. The subways of New York and Boston were not constructed until after all other classes of transportation had reached their limit of carrying capacity. Under these conditions only will the subway, as a subway, pay its way. As an inlet for an extended system of surface lines serving a large territory, the governing reasons for the adoption of a subway change to such an extent that its construction is occasionally warranted. The location of the main branch of the subway proposed is from St. Clair avenue down Yonge street to Queen, a distance of 13,375 ft. of double track; a single track downtown subway loop, 2,240 ft.; a double track subway in Bloor street, 2,700 ft.; double track under embankment drive, Sherbourne to Parliament, 1,600 ft.; double track under bridge driveway over Rosedale Valley 565 ft.; double track subway Valley Bridge to Don River bridge, 970 ft.; double track under bridge driveway over Don River, 1665 ft.; double track subway, Don River bridge to Broadview, 450 ft.; a total of four miles of double track and approximately one-half mile single track.

The subway would be fed by an open territory capable of expansion to a surface system of 27 miles of single track to the north and about 17 miles to the northeast, the total being given as 44 miles of single surface track. The surface additions proposed are practically the same as those recommended in connection with the unifying of the system using all surface lines, only small changes being made in the details of the routes.

It is estimated that 150 cars would be sufficient to operate the underground and surface lines giving a 1½ minute service throughout the greater part of the subway system and a ¾ minute service below Bloor on Yonge. This service would be capable of handling 10,000 passengers per hour. It is calculated that the subway would be capable of eventually carrying over 250 cars per hour, but this would be at a considerable sacrifice of speed. The estimated cost of the whole alternative system, including subways, surface tracks and all the necessary auxiliary equipment is placed at $10,4[illegible],000, distributed approximately as follows:

Costs

- Double track subway in Yonge street $4,328,000
- Single track subway loop 496,000
- Danforth Avenue Branch (Yonge to Broadview) . . 1,338,000
- Carrying charges on terminal system (7½) per cent. during construction (2½ per cent. per yard). 462,000
- Double track surface lines (17 miles) 1,400,000
- Single track surface lines (10 miles) 472,000

P-A-Y-E steel cars (150 at $8,500)	1,275,000
Car houses	320,000
Substations and equipment	242,000
Miscellaneous—work cars, line wagons, snow, ice, and sprinkler equipment	50,000
Total	$10,473,000

It is calculated the gross receipts from the first year's operation of this system would be $1,204,000. After deducting 62 per cent. for operating expenses and maintenance, there would remain $457,520 to meet fixed charges, renewals, taxes and amortization.

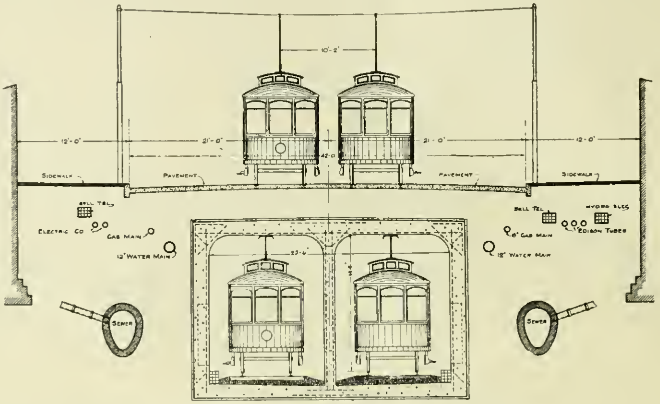
Motor Busses

A section is devoted in the report to the success that has attended the operation of motor busses in a number of cities situated somewhat similarly to Toronto. Their use in Toronto is not considered advisable. The motor bus can be profitably operated only in districts where traffic is continuously heavy, on short hauls from one congested centre to another, or by charging more than the regular street car fare. Toronto conditions do not seem to warrant the experiment.

A number of experiences of other cities are recounted. In New York City for the year 1911 on a gross business of $500,000, a deficit of $38,000 was reported. This was a 10c fare.

With reference to the question of routing the suburban cars over the present city lines, the report points out that the matter is somewhat complicated owing to the several Toronto companies using different widths of tracks varying from 4 ft. 8½ in. to 4 ft. 11 in. The joint use of the city tracks will require a change in the gauge of either the city or the radial lines to conform to some agreed standard, preferably 4 ft. 8½ in., before such service can be inaugurated. The city lines are 4 ft. 11 in. gauge. The report then goes on to suggest the basis of agreements by which the outlying lines, especially the Metropolitan, would be allowed to use the city tracks.

The report contains a number of very useful and interesting photographs and diagrams, a few of which we reproduce. Fig. No. 1, in the report, represents the actual distribution of the sleeping population of Toronto; No. 2 shows the present tracks of the Toronto Railway Company; Fig. 3 shows a suggested arrangement for tracks of different gauge in the centre of the same street, shown herewith; Fig. 4 is a map showing the complete proposed system of tracks for the Greater Toronto district shown herewith; Fig. 5 shows the proposed new tracks for the Greater Toronto district; Fig. 7 shows cross sections of the modern grooved rail and the accompanying track construction. Fig. 8 is a cross section showing modern T-rail and track construction. Fig. 9 is a cross section of a standard conduit construction. Fig. 10 shows a plan and section of a standard manhole; Fig. 11 shows a typical track layout on a heavy business corner; Fig. 12 shows a plan in section of a modern p.a.y.e. car; Fig. 13 seating arrangements of same; Fig. 14 is a plan showing the arrangement of tracks and rooms in a modern car house; Fig. 15 shows an elevation and section of same; Fig. 18 represents the alternative layout, including the proposed subway, terminal, and surface tracks in the suburban districts feeding the subway; Fig. 19 is a plan showing a single track subway station; Fig. 20, a double track subway station; Fig. 21, shown herewith, a cross section showing proposed double track subway; Fig. 22 showing proposed single track loop in the heart of the city; Fig. 23 is a cross section of proposed single track subway; Fig. 24 is a cross section showing concrete elevated structure for use on a private right-of-way; Fig. 25 is a cross section showing proposed tracks on River and Valley bridges connecting Bloor street and Danforth avenue; Fig. 26 shows typical sections of roadway construction for tracks in the Rosedale Valley.



Cross section of proposed double track subway.

Moose Jaw Electric Railway

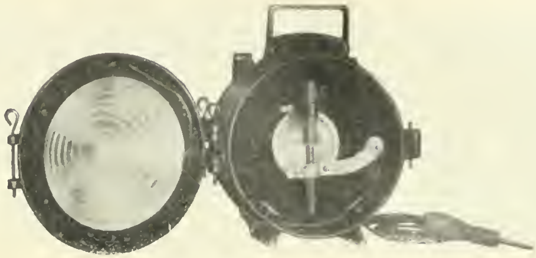
The annual meeting of the Moose Jaw Electric Railway was held in Moose Jaw on Wednesday, April 30th, and the reports showed that very satisfactory progress had been made in the past year. A total of 1,607,770 passengers were carried during the year and the gross receipts were $77,996. A dividend of six per cent. was declared. In view of the fact that nearly all the directors of the company are Ottawa men, it is interesting to note that the results of the first year's operations of the Moose Jaw electric railway closely approximate those of the first annual report of the Ottawa Electric Railway Company, which carried 1,520,408 passengers and earned $71,698 in its first year, though Moose Jaw is at present only half the size Ottawa was when its street railway was started. These results are indicative of the greater present-day activities of the average citizen.

The assets of the Moose Jaw Electric Railway are placed at $573,367, of which $570,128 is in plant, property and equipment, and the balance of $2,239 is in accounts receivable. The liabilities are, capital stock (paid up), $480,271; bills payable, $15,359; accounts payable, $22,581, and a profit and loss surplus of $15,359.

The earnings of the company showed a steady increase month by month and indications are that the increase will continue. At present the company has nine miles of track in use and operates twelve cars. Eight miles of additional track are to be added this year and an order for ten new cars has been placed with the Ottawa Car Company, two of which have already been shipped.

The board of directors elected were:—president, A. A. Dion; vice-president, Newton J. Kerr; secretary-treasurer, D. R. Street, E. J. Daly, E. O'Connor, T. Frank Ahearn, P. B. Mellon, A. H. Dion, and Charles E. Armstrong.


Type "LK" front view


Type "LK", front door open.

New Type of Headlight

The accompanying illustrations show a new type of luminous headlight just placed on the market by the Crouse-Hinds Company of Canada, Limited. These new headlights, named the "Imperial," are manufactured in two types, "LK" and "LP." Both have cast iron cases which are divided into two compartments, the front compartment containing the electrodes, electrode holders and a 4-inch spherical aluminium reflector. The rear compartment contains the operating mechanism.

This form of construction protects the operating mechanism from the fumes and deposits caused by the consumption of the electrodes which would in time prevent the proper performance of the headlight. All parts within the case are mounted directly to the barrier separating the two compartments. Each compartment is provided with a cast iron door which permits easy access to the interior parts.

The upper electrode (positive) and the lower electrode (negative) have an approximate life of 4,000 and 125 hours respectively. No inner globe is required, which, added to the low cost of electrodes, reduces maintenance charges to a minimum. The height of the head light is 12½ in., width 12½ in., depth with regular semaphore lens 8 in., weight 35 lbs.

The type "LP" head light is arranged for bolting directly to the dash of the car. The rear door is drilled and tapped for ½ in. conduit through which the lead wire enters the headlight and connects with a contact plate secured to the inner surface of the door. This contact plate engages a spring contact which connects with the mechanism and thereby completes the circuit. Both types operate at 550 volts, direct current, and require from 2 to 4 amperes.

Ottawa Electric Railway Company

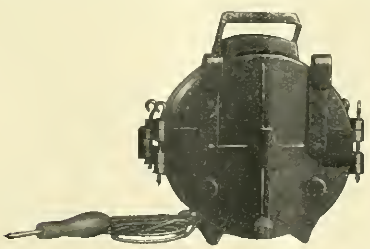
The Ottawa Electric Railway Company have decided to change the color of the exterior of their cars from a dull red to a rich dark green. The object of adopting the different color is because it has been found by other street railway corporations to wear better and retain a good appearance much longer. The 20 new cars to be put into use next month will be green, and the present cars will be given the new color as they go into the shops to be repaired.

After some discussion between the city council and the officials of the Ottawa Electric Railway Company over the application of the latter for permission to cut off 18 inches of the sidewalk at the corner of Queen and Elgin streets to provide for double tracks leading from Queen to Elgin, the matter has been satisfactorily settled. The owners of the building on the corner in question who are also owners of the sidewalk there have agreed to deed the required 18 inches to the city for the benefit of having a double street car track. It was at first intended to put a single track on Queen street, but following a conference with the civic officials the company have given their promise to proceed without delay with the larger proposition. Work on an extension of the street car lines is to be started at once along Preston street and from the Exhibition grounds to within about 200 yards of Billings Bridge along Bank street.

Ottawa Cars for Moose Jaw

Two more of the ten single truck cars for the Moose Jaw Electric Railway have just been shipped by the Ottawa Car Company, making a total of four shipped to date. The other six are now under construction. These cars have a seating capacity of 32 in 11 cross seats and two longitudinal. The cars are exactly similar in design to the new cars used by the Ottawa Electric Railway. The total length of the car body is 21 feet; total length over bumpers, 31 feet; length of front vestibule, four feet; length of rear vestibule, five feet; exterior width of body, 8 ft. 1¾ in.; interior width of body, 7 ft. 3½ in.; width of aisle, 20 inches; approximate weight of car body, 12,000 pounds. The interior finishings are in red cherry and bird's eye maple veneer. Peter Smith electric heaters are installed and all the other fittings and appliances are thoroughly up-to-date. Each car costs $5,200.

The horse cars along 10th avenue, the lower east side and crosstown, New York, are to be replaced by storage battery vehicles, the Public Service Commission having granted an application of the Belt Line Railways to make the change.


Type "LK", rear view.


Type "LK", rear door open.

Illumination

Electric Lighting in the Home—Modern Requirements in Outlets and Switches

By Mr. F. B. Adam

With the introduction of the Tungsten high incandescence lighting units, an immediate change was found necessary in the scheme of locating and supporting these lamps, and to-day we find in properly designed installations, more outlets of a minimum candle power and always high enough to prevent a direct glare from the lamp into the eyes.

In residences, this means in very large rooms two, four, five or six 25 to 60 watt individual pendants close to the ceiling, instead of the 6, 8 or 10 light chandelier, in the center of the room and coming down as low as six feet two inches from the floor. In the smaller rooms, one or more 25, 40, 60 or 100 watt lamps are used for general illumination and a 15 or 25 watt lamp for the dresser lights. In the bath room, a 25 watt ceiling light, with a 15 watt lamp on each side of the mirror for shaving, and a 15 watt lamp in the closets, will give ample light.

Plug Outlets

Now, in addition to these permanent fixture outlets for lighting, it has become necessary, because of the socket being close to the ceiling, to provide plug outlets for portable lights.

You will find to-day portable table, piano and stand lamps on sale, not only in the lighting fixture stores, but in jewelry stores, hardware stores, department stores, and, I am told, even in the ten cent stores, and you can hardly find a home using electricity that has not at least one, and usually several, portable lights. Therefore, the architect and owner should provide for the convenient connection of such portable lights. Strange as it may seem, the architect specifies Underwriter's inspection and a certificate for the original installation, and then, by not providing for the convenient connection of portable light, heat and power devices, endangers the owner's property when temporary and unsightly connections are used for such devices. It is acknowledged to be a fact that there is danger in the temporary wiring, when used for permanent connections.

As to the number of location of plug outlets, I have in mind an installation where I recommended at least one receptacle in each room and hall on the first and second floors. As the owner purchased his furniture, he found that the locations decided on for these plug outlets did not suit the location of the furniture and we put an additional plug outlet in each room, and after the owner moved into the house he told me he had only one kick coming on the job, and that was that he had not put a plug connection in each of the four corners of each room and hall. As this man is in the electric business, we might excuse him as trying to overdo the good work, but it is a fact that the housewife may want to move the piano, desk or any other piece of furniture into any one of the four corners of the room. Then why not provide for the lighting of the piano or desk in any position that might be convenient or suit the idea of the owner. We should provide for plug outlets about as follows:

Entrance hall—At a convenient point, a stand or table lamp for general illumination.

Parlor—Piano lamp, also table lamp.

Living room—Table lamp in center of room, desk damp for writing desk and lamp for lighting book case.

Dining room—Stand or table lamp for general illumination.

Bed rooms—Table or bed clamp lamps.

These few plug receptacles will cost very little when installed during the construction of a house, and will make a better job with a minimum length of attachment cord to the portable light.

Before leaving the lighting outlet section, I want to suggest something that I believe is new (as we have never seen it specified, but have installed it ourselves) for the first class installations, and that is to specify a separate circuit for the ceiling lights and a separate circuit for the brackets, toilet or plug outlets. With the advent of innumerable heating and cooking devices, the blowing of a circuit fuse has become a regular thing, not from any fault of the lighting system, but entirely on account of overloading the fuse by adding a device that was not intended to be connected to the circuit in addition to the lamps, and the owner will appreciate the benefit of a second circuit in the room when the fuse blows on the first one.

Switches

Strange as it may seem, we have just as much trouble to-day in convincing the architect and owner that the job requires two and sometimes even three switches to control the lights properly in the main rooms, as we used to have ten years ago in convincing them that they should have at least one switch, but the necessity for more switches in the principal rooms should be immediately appreciated when we realize that the lamps and sockets are to-day, in a properly designed installation, close to the ceiling, and for the convenient and economical use of the electric service there must be plenty of switches.

Let us start this time from the porch. One switch for either one or more outlets is usually sufficient.

Entrance hall—Here we should have one switch that will control just enough lights for the general illumination. This switch should be in combination with a switch in the rear of the hall, one on the second floor and sometimes even one on the third floor. These combination switches for the hall and stair lights will pay for themselves many times in the course of the occupancy of the building. Besides the combination switches for the general illumination, there should be a second switch to control the balance of the lights on the fixture.

Parlor—The parlor should be equipped not only with two switches for the ceiling lights, but, on account of the usual style of fixture, with switches for brackets, if brackets have been decided on.

Living room—One switch should be prepared for the reading or table lamp, and not less than two switches for the

ceiling outlet, one for the general illumination and one for the better illumination.

Dining room—One switch for ceiling lights for general illumination, in many cases this should be in combination with a second switch placed at the door to the pantry, which will pay for itself by less damage to glass and chinaware. A second switch for the balance of the ceiling lights, and if brackets are used here again they should be controlled by a switch.

Kitchen—One switch.

Pantry—One switch.

Basement stair—One switch, and it will be better yet if in combination with another at foot of stairs.

Second floor hall—If this hall requires only one lamp, it of course should be arranged with a switch in combination with a second switch on the first floor, and a third switch if there is a third floor. If more than one lamp is required for the second floor hall, it will be found economical and convenient to have a second switch for the balance of the lights on the fixture.

Bed rooms—Here again if the room is large enough to justify more than one lamp ceiling fixture, it will be found both economical and convenient to the house owner to have one switch for the general illumination and a second switch for the balance of the lights on the fixture.

I wish to say that from my personal experience it is far better to install two or more separate switches than to use what is known as an electrolier switch, as with a separate switch you turn on and off just the light you want, while with an electrolier switch you must turn on everything to get what you want, and in my opinion it is false economy, as the additional cost of the separate switch per section controlled amounts to only about 75 cents.

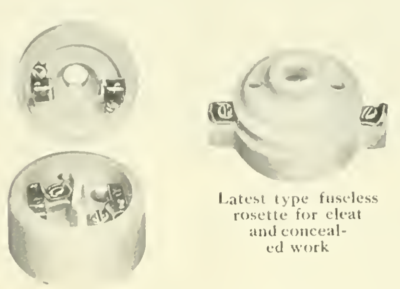
Bath rooms—A switch should always be used for the ceiling light and, as a matter of fact, a switch should also be used for side lights, as, even though using the greatest care, a person turning on a light with a key or pull socket might have the other hand touching a plumbing fixture or actually in the water, and through a defective connection in the socket or fixture receive a severe shock. Where a bath room is used for two bed rooms, it will be found of the greatest convenience to use two and even three switches in combination, so that regardless by what door the bath room is entered, a switch is conveniently at hand.

Closets—The convenience of a closet light can only be appreciated by those using them and the benefits derived from an automatic switch are even greater than when the closet light must be turned on and off every time you want to get something in or out of the closet. The objection I have heard voiced against automatic closet switches is that the closet cannot be properly aired and taken care of and that here is a waste of light when the door is opened, but this can be remedied by a key socket so that the light can be turned off when desired. However, the convenience of an automatic switch in giving light the moment the door is opened should certainly be appreciated.

We should n t f rget that the greatest argument in favor of the electric lighting service is its practical application and control.

Latest Type of Tungsten Rosette

The accompanying illustrations show the latest type of fuseless rosette for cleat and concealed work, manufactured for the Canadian market by the Canadian General Electric Company. There is nothing particularly new or novel in this little device, but its rigid construction, and the extreme ease with which it can be installed and wired should highly recommend it to the electrical trade. In both the cleat and the concealed rosette, contact is made between circuit and the pendant by a pair of spring bayonet clips. These clips are made of extra heavy metal, and they have to carry the weight of the lamp and shade. The contact parts are slight-



Latest type fuseless rosette for cleat and concealed work

ly curved, so as to give a minimum amount of surface, and thus avoid any liability to heating, and consequent annealing of the springs. These curved contact surfaces also avoid the danger of the cap jarring loose, and allowing the pendant to fall. The concealed rosette is made with a deep base, and recessed in the back to allow space for the ends of the tube to project slightly. This makes the use of a sub base necessary, thus saving considerable time in wiring. The brass terminals are liberally designed and the screws fit up close to the grooves, so that there is no possibility of the wire squeezing out, which has been a prolific source of rosette troubles. The above features, combined with a clean cut porcelain, entirely free from burrs and cracks, make up an exceedingly neat and serviceable wiring device.

A Large Outdoor Reflector

For the new two, three and five light fixture put on the market by the Line Material Company of South Milwaukee, a 26-inch radially fluted reflector is provided which is claimed to be the largest of its kind that has been used for this purpose. There are various types of this "many light" fix-

"Many Light" Street Fixture

ture made—for bracket suspension, mast arm suspensions, pulley and rope suspension and for span wire suspension. One of these arranged for span suspension is shown in the accompanying illustration. Swiveling at two points insures the hanging of the reflector in a horizontal plane, but by tightening the half-inch bolt above the reflector the fixture can be made rigid if desired.

Importance of Correct Store Lighting

The lighting of every kind of store is of prime importance, for the successful store keeper must be up-to-date and progressive in all phases of his business. In this age of keen competition, particularly in the retail lines, the shop keeper, to be ultimately successful, must scrutinize carefully every detail of his store arrangement quite as much as his business methods. His store must first be arranged to attract trade and then, when the public has been interested, their trade must be kept by proper goods properly displayed, and courteous attendance. There must be nothing that will tend to displease customers and cause them to go elsewhere. Not only must the quantity of light be correct but the quality must be such as to insure the advantageous presentation of goods without any discomfort to the customer, such as eye-fatigue, etc. In this connection much will often depend on the artistic effect produced by the general illumination or by the fixtures themselves. If customers get into the way of considering a certain store as being properly and artistically arranged they will naturally fall into the way of associating this same store with the properties along the lines of their own requirements.

Four primary factors may be said to enter into the consideration of store lighting. These are intensity, colors, diffusion and even distribution.

Intensity

It is a recognized fact that there is a certain range of desirable intensity of illumination for each class of work in a factory and for different classes of goods on display in the various stores. It is often complained of that modern illumination brings out bad qualities in the goods. This is probably true but these defects must be recognized as inherent in the materials themselves and not the result of any fault of the illumination. Good business methods too recognize the necessity of having any article of merchandise appear to the customer as it actually is. In the long run there can be no advantage in deception. Unfortunately there are customers who do not yet recognize this fact and some indeed whose prosperity to-day is largely the result of deception. This class of dealer often places the engineer in a false and difficult position. In the better stores the designer of course, has a freer hand and he can arrange his intensities so as to bring out the best characteristics of the goods. The intensities must vary of course, with the goods displayed, as for example, a piece of black velvet will require a different intensity of light from white dress goods.

Color of Light

In the large departmental stores and in the better class of specialized stores this factor of color is of considerable importance but in the small store or shop it is often not considered. Color matching is getting to be considered of more importance than formerly and a color matching device is now on the market which passes the light from an incandescent or arc lamp through absorbent glass screens of different qualities and colors. This subtractive method screens out to a considerable extent the excess of color rays and produces a spectrum which corresponds very closely to that of ordinary daylight.

But in the average store color lighting is not yet of importance, customers preferring a store which is cheerful and inviting with a light which is a compromise between daylight and the average night illumination. It is a point to be considered that the finest and most expensive goods purchased will, for the most part, be used at night under conditions of illumination very similar to those under which they are purchased. Therefore it may justly be argued, why should we not sell goods under the conditions under which they will have the most critical use. Aside from the use of daylight illumination for matching purposes this argument will doubtless continue to carry much weight.

In the larger stores it has come to be considered a necessary practice to have a certain portion or corner however where an artificial light equivalent to daylight is available for matching delicate shades of silks, ribbons, etc., which will be worn under different lighting conditions. This is also necessary for distinguishing colors which are more or less similar, as blues, dark greens and blacks. For this purpose a color matching device mentioned above is coming to be used fairly extensively. The mazda lamp has been pretty uniformly adopted for store lighting on account of its availability in small units even though its efficiency is not so great as that of arc lamps. Under certain conditions however, the arc lamp is giving most excellent results and is giving a color effect as near to daylight as has yet been obtained. Sometimes the tungsten lamp is used at different intensities in different parts of the installation, as for instance, in the jewelry department where a brilliant light is desirable the lamp is run above its normal voltage, and in the furniture department where a light tending to red is desirable, the lamps are operated at low voltage.

Diffusion

Glaring sources of light should be distinctly avoided, even though in securing proper effects there is a considerable loss of total light. The gain in the ability to see properly usually off-sets this loss. The lighting scheme should be such that neither the light sources nor the effects produced will be injurious or objectionable to the eye. Proper diffusion is now being obtained by the use of various kinds of reflector and diffusing glassware in both direct and indirect adjustments. Best advices can probably be obtained by the use of semi-indirect lighting though this is often at the expense of a considerable loss in efficiency.

Even Distribution

Proper distribution is one of the essential factors in the design of a lighting installation for a store. Deep shadows must be avoided and all places where goods are on display should have an equal share of the total amount of light. This can be accomplished only by proper spacing, height and choice of lamps and reflectors. The methods of determining these conditions are becoming pretty well understood but are sufficiently important to justify consultation with a properly qualified illuminating engineer before the lay-out is decided upon.

The Ohio Brass Company of Mansfield, Ohio, was recently awarded a contract by the Boston Elevated R. R. Co. for 610 automatic air connecting coupler and draft gear equipments for heavy subway and elevated train service.

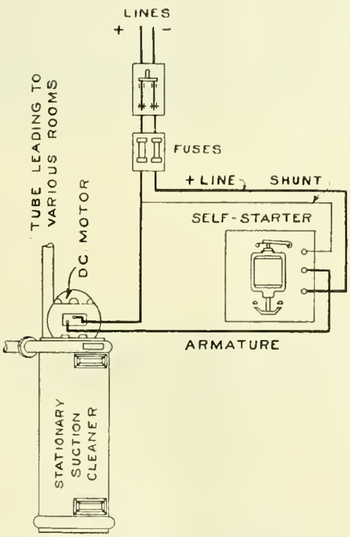
The Zorra Telephone Company, Limited, has been incorporated with a capital of $6,000 to carry on the general business of a telephone company, with head office at Embro, Ont., The provisional directors are G. A. Munroe, Jas. Crang, farmers of the township of West Zorra, and Dr. R. H. Green, Embro, Ont.

At a recent session of the Board of Grain Commissioners of Canada held at Vancouver, representatives of the B.C. Electric Railway Company and the Western Canada Power Company submitted estimates outlining the probable cost of supplying power for the operation of grain elevators at the Coast. It was pointed out that each elevator would require 1500 horse-power. Following a discussion as to the load factor, the continuity of the power, etc., the representatives of the two companies were requested to submit estimates to the board at its headquarters at Fort William, Ont.

The Dealer and Contractor

Control of Stationary Suction Cleaners

The accompanying illustration shows an installation of a motor driven cleaner and the wiring necessary using a single step self-starter. These self-starters are designed for use in connection with a double-pole main line switch, as shown in the drawing, for starting small motors of a capacity from ¼ to ¾ of a h.p., 115 and 230 volts. This particular self-starter is provided with a single step of starting resistance



Motor controlled by single-step self-starter

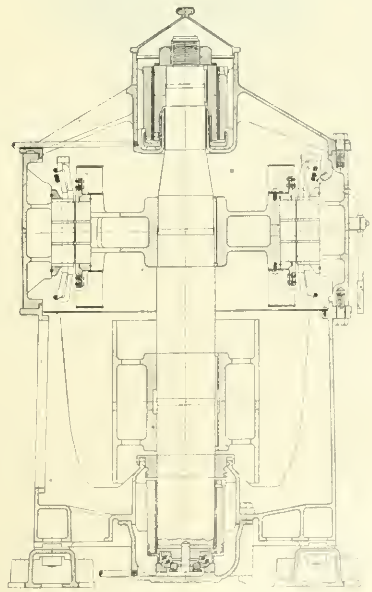
which is cut out automatically by the action of the self-starter solenoid when the motor has attained approximately one-half its normal speed. Being automatic in operation these self-starters will be found suitable for use in many other cases in connection with devices operated by small motors. The overall dimensions of the self-starter are about 6 in. x 7 in. The double pole switch may be placed at any point most convenient to the person who will be operating the cleaner.

"Made in Canada" Lamps

The entire "Made in Canada" train, which is to tour the Dominion, is lighted with the "Nulite" tungsten lamps of standard 60 watt, 115 volt type manufactured by the Canadian Tungsten Lamp Company, Limited, of Hamilton. This exhibit will enable all who are interested to judge the durability of the Nulite drawn wire continuous filament tungsten lamp and will create much interest throughout the Dominion, as it should prove conclusively the adaptability of tungsten lamps to places where they are subjected to severe and prolonged vibration. Dealers who are contemplating placing their contracts for the coming season will do well to make an inspection of the lamps on this train and assure themselves of their high quality.

A New Vertical Motor for Cement Mills

To provide a thoroughly satisfactory drive for vertical machinery (such as grinders and pulverizers) in cement mills and other places where the service is very severe, the Westinghouse Electric & Manufacturing Company have built a line of specially designed vertical motors in sizes varying from 75 to 200 h.p., for both direct and alternating current circuits. The special feature of this motor is its strong, rugged construction. The motor frame is supported by a massive cast iron base, which rests on slide rails with belt-adjusting screws. The shaft is of very large proportions and the bearings are designed to withstand the severest stresses. The weight of the motor and the major part of the horizontal thrust due to belt tension are carried by a ball bearing



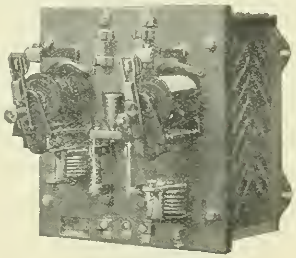
Vertical type cement mill motor

mounted within the motor base. This bearing is housed in an iron case and can be easily removed if the necessity arise. The bearings are automatically oiled, the oil being forced between the bearing surfaces whenever the motor is in motion. The ball thrust bearing runs immersed in oil. The

pulley is mounted inside the thrust bearing, which, together with the strength of the shaft and the rigid support afforded by the motor base, insures the elimination of distortion due to the belt tension, so that the proper clearance is always maintained between the stationary and rotating parts. The commutation of the direct current motor is practically sparkless, so that brush renewals are rarely required and commutators are long lived. The principal features of construction are shown in the accompanying illustration.

New Cutler Hammer Automatic Motor Controller

For the automatic starting of motor-driven machine tools, pumps, fans, etc., it is only necessary to close the knife switch which is mounted between the two solenoid switches on the automatic starter shown in the accompanying illustration. With this type of series relay self starter, made by the Cutler-Hammer Manufacturing Company, of Milwaukee, the resistance is cut out of circuit and the motor automatically accelerated, the starting current, however, being kept below a safe maximum value. The magnetic switches close in succession controlled by the motor current through the relays. These relays are quick and positive in action so that when the motor starts under light load it will be accelerated quickly while, if under heavy load, the resistance is cut out more slowly, but in all cases the



Automatic Motor Controller

current to the motor is kept to a safe value. Where the load driven varies this type of starter is especially adapted as there is no danger of the operator damaging the motor or machine through improper starting—he is relieved of all responsibility and needs only to close the switch and the starter does the rest. This type of automatic controller is made in capacities up to 15 h.p., 230 and 500 volts and up to 7½ h.p. for 110 volts.

A similar type with the same kind of new magnetic switches is also made having a main line magnetic switch with blowout, in place of the knife switch, which allows control from a push button, float switch or pressure regulator. The use of a main line magnetic switch allows the use of controllers of large capacities, the latter being placed out of reach

Mr. Irving Smith announces his change of address from 406-407 St. Nicholas Building, Montreal, to Room 809 of the new Unity Building, corner Lagauchetiere and St. Alexander streets where he will still continue carrying on a manufacturers' agency business of electrical apparatus and specialties.

The 36th convention of the National Electric Light Association will be held in Chicago on June 2, 3, 4, 5 and 6. Special rates have arranged with most of the railways leading to Chicago. The association has issued a pamphlet giving the approximate railway rates from various points in the United States, and Montreal, in Canada. Mr. G. W. Elliott, 29 West 39th street, New York, is chairman of the Transportation Committee.

Largest Commercial Switchboard

Our illustration shows the largest commercial switchboard in Canada, which has just been installed in the Windsor Street Station of the C. P. R., Montreal, by the Bell Telephone Company. The switchboard is of the No. 4 lamp signal multiple board type, with developments to suit the peculiar conditions of the C. P. R. Company. It is of the latest de-

Switchboard in C. P. R. Windsor Station

sign, with lamp line signals, audible busy tests, and lamp disconnect signals. Although eight operators are now engaged in handling calls, the switchboard has a capacity for ten positions. The board is divided into two sections, the first four positions handling originating business and the other four the incoming business. Each position consists of two panels, making sixteen for the whole board.

The capacity limit is 1200 local lines and 160 trunk lines; at present the board is wired for 500 local lines and 100 trunk lines, of which 225 local and 50 trunk lines are now in use. These, however, are to be increased by 50 and 40 respectively.

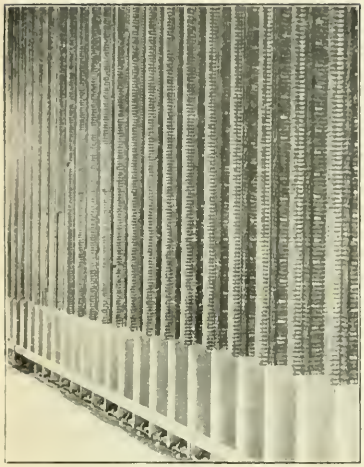
The telephone room is located in the tower of the old portion of the station, where the company have also provided a rest room for the operators.

Selling "Service" with Electric Trucks

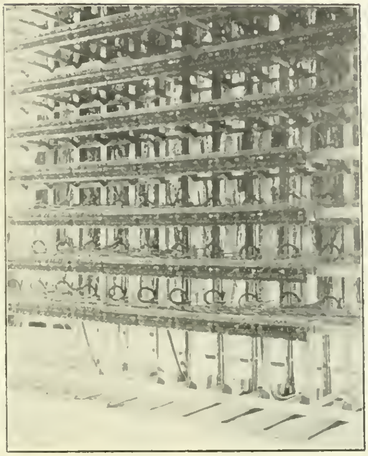
A Hartford, Conn., dealer has introduced a novel method of selling service with electric trucks. The method consists in selling the vehicle without a battery and charging the owner of the vehicle a certain rate for battery service. This arrangement is made more easily possible in that the dealer is closely associated with the local electric light and power company.

Under the provisions of this battery service contract the user may, if he wishes, operate his car twenty-four hours a day, the company providing another battery when the first runs out. In the case of cars doing a big mileage, two changes are frequently made in one day. The charge is based on mileage. For example, a 750 lb. car is supplied with battery service at 5½c. per mile provided it is operated 500 miles per month. If the car runs 1,500 miles the charge is 3c. and for 2,000 miles 2.6c. per mile.

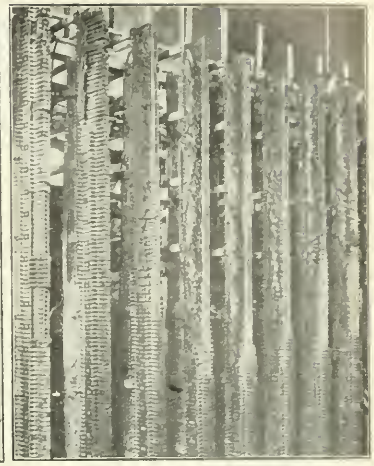
The advantage to the truck owner is that he always has battery service. Instead of boosting at certain hours he now runs around to the station and takes on another battery. On a 1,000-mile basis it is calculated that the truck owner saves $12 a month, assuming current at 4c. In this particular case Edison batteries are used.



As main frame should look, B. C. Tel. Co.



As main frame should look



Destroyed by short circuit

Switchbord Troubles

The New Westminster Exchange of the B. C. Telephone Company was severely handicapped recently when the wires of the main frame were completely destroyed by a short circuit. Occurring early in the morning when the office staff was smaller than at any time during the day, the fire which followed gained considerable headway before the arrival of the city fire brigade. It was eventually ascertained that one of the drop wires became crossed with an overhead trolley wire, and the 500 volt current came into the exchange over a cable pair. The high voltage came through the pothead and cable to the horizontal side of the main frame through the jumper wire to the protector, which it operated. The heavy current caused an arc which jumped to ground on the frame and protector, and maintained a flame which could not be conquered by sand or fire extinguishers.

Destroyed by Short Circuit

The entire main frame with the exception of the iron work was destroyed. Owing to existing conditions, officials had to turn in to repair the damage, and by continuous and excellent work complete service was resumed in less than a week.

New Companies

The Renfrew Electric Manufacturing Company, Limited, has been incorporated with a capital stock of $50,000 to carry on business as machinists, foundrymen, manufacturers and dealers in electric machinery, etc., with head office at Renfrew.

The Sangamo Electric Company of Canada, Limited, has been incorporated with a capital stock of $50,000 to carry on business as manufacturers, importers, exporters, etc., with head office at Montreal.

The Silver River Power Company, Limited, has incorporated with head office, Vancouver

New Books

House Wiring.—By Thomas W. Poppe, electrical engineer and contractor. The Norman W. Henley Company, New York, publishers. This is a treatise describing and illustrating up-to-date methods of installing electric light wiring. It is intended primarily for those who are desirous of obtaining a practical knowledge of the subject. Only practical examples of work are included and the matter is treated in a simple, non-technical way. The illustrations used help to make the various operations clear. This work should prove of special value to apprentices, helpers, and electricians, and even the advanced electrical worker will find a number of labor and time saving suggestions which he can utilize. The book is convenient pocket size, price 50c

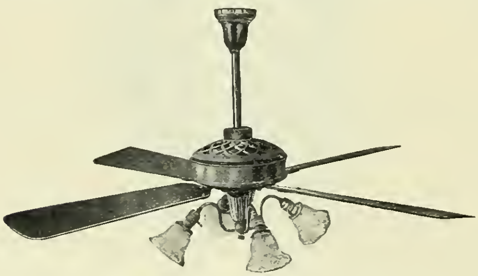
Electric Arcs—By C. D. Child, Ph.D. The D. Van Nostrand Company, New York, publishers. Price $2 net. This is a compilation of experiments on arcs between different electrodes in various environments, with explanatory notes. Special attention is paid to the explanation of the arc phenomena and to recent investigations such as experiments on the mercury arc. A few pages are given to photometry and to the whistling arc. The writer has endeavored to keep in mind the needs of investigators who may come after, and references have been given to important articles on the subject. The illustrations and type are both excellent.

Bell Electric Motor Co.

The Bell Electric Motor Company of Garwood, N.J., announce that they are constructing two modern fireproof factories, steel and concrete construction, about 200 feet long, to be used with their present factory buildings, as soon as they are completed. These buildings are expected to be complete in about three months' time. Special attention has been given to securing perfect daylight by means of windows running the entire length of factory. Also special attention has been given to the installation of up-to-date testing apparatus by means of which they will be enabled to generate single phase, two phase and three phase current of all commercial voltages. There is also an extra railroad siding being run to connect these factories with their other factory buildings. The company announce that their sales of Bell single phase motors have doubled during the past year.

Century Fans

A descriptive bulletin has just been issued by the Century Electric Company, descriptive of their alternating current fans. These include desk and bracket types, four blade, operating on cycles from 25 to 133, and in sizes from 12-in. to 16-in; residence type fans, six blade, for 40, 50 or 60 cycles; and ceiling fans, four blade, 25, 30, 40, 50 and 60 cycles; types other than those included in the above are made to special order. The cut shown herewith represents one



Combination 58 inch fan and electrolier

of their 58-in. ceiling fans. It consumes 140 watts operating 240 r.p.m. at 60 cycles. The motor is induction type so that there are no moving contacts. The fan blades are made of carefully selected kiln-dry material. It is not necessary to disconnect any wires to take off the oil cup and bearings or to take out the armature for cleaning unless the fan is fitted with electroliers. The oil cup is specially arranged to carry electrolier arms, however, as shown in the illustration.

Insulated Aluminium Cables

The Paris Omnibus Company has placed an important contract for aluminium armored cables for tramway feeder networks. The cables will have cross sections up to 1,000 square millimeters (1.55 square inches), and are for a pressure of 500 volts. The order comprises some 300 tons of metal, and is expected to show an economy of 8 to 10 per cent. as compared with the cost of copper cables. Including cables already installed of a net weight in aluminium of about 300 tons, there are in service, or on order, insulated cables employing a total of 600 tons of aluminium in this company's system.

Free Renewals of Tungsten Lamps

The Hartford Electric Light Company has instituted the policy of giving free renewals of tungsten lamps in sizes of 60, 100, 250, 400 and 500 watts. This offer is restricted to one renewal per socket per year. Renewals are not made, however, for the 25 and 40-watt sizes, but a charge of 20 cents each is made for 40-watt lamps and 40 cents for 25-watt lamps.

New Ottawa Exchange

Work on the building of a new telephone exchange for Ottawa is to commence forthwith. This will give Ottawa two branch exchanges and the new one will be known as the "Carling." The contract for the switchboard has been let to the Northern Electric & Manufacturing Company and will have an ultimate capacity of 8,800 subscribers. It is proposed to have the new exchange in operation early next year. The site for the building is on the corner of Carling avenue and Bank street. The opening of the new exchange will involve a number of alterations to the present Central and Rideau exchanges.

Underground in Hamilton

Following a recent decision of the Dominion Railway Board all companies using wires on the main streets of the city of Hamilton will place these in underground conduit. The date by which all this work must be completed is July 15, 1913. By the decision the Bell Telephone Company are allowed to use their own conduits, but the municipal distributing system, the Hamilton Electric Light Company and the telegraph companies will use a conduit system to be installed by the municipality and for which rent will be paid. The amount of the rental will be fixed later by the Dominion Railway Board.

Light and Power in Dorval

In connection with a scheme for converting Dorval Island, on the River St. Lawrence, P.Q., into a residential district, plans have been drawn up for an installation of power and house lighting and of tungsten street lighting. Power is to be taken from a power house in Dorval, current being supplied by the Montreal Light, Heat and Power Company, and brought down on poles to the water front. From there, by means of a submarine cable, power will be conveyed to the island, where a receiving station will be constructed. The power taken from Dorval is three-phase, 60-cycle, 2200 volt. The street brackets will be Hubbell No. 999 Schedule T tungsten street fixtures. Eight single-phase lighting transformers 2200-1100 volt and secondary voltage of 220-110 will be required. For pumping sewage two centrifugal pumps motor-driven, together with the necessary transformers, will be installed. Dupont, Roy and Baudouin, Montreal, are the engineers for the Dorval Island Park Company.

Relief from Congestion

As the result of a conference with the Board of Control, the directors of the Montreal Tramways Company have made proposals for relief of the congestion on the system. The proposals are intended to give immediate relief only, and the company suggest that permanent and elastic plans should be later drawn up to provide for the future growth of the city. In order to give an increased service in the down-town district, the company ask permission to re-route several lines. Also to relieve the north-eastern section a number of new routes are suggested. The plans also provide for three new routes which would give accommodation for the St. Catherine street traffic. The elimination of stops at unimportant points would assist in giving a faster service. These changes, the directors state, would enable the company to add further 200 cars over and above the 200 cars now being delivered. The use of Victoria Square as a turning point for some lines is an essential part of the proposals. The company intend to order 100 cars from the United States, owing to the difficulty of securing quick delivery from Canadian firms.

A Vigorous Western Firm

The business of the firm of Taylor & Young, Limited, shown herewith, is principally a combination of general consulting engineering with the sale of heavy machinery including pumping, power plant and machine shop equipment. The firm have been careful in organizing a well-balanced staff and in selecting the manufacturers they represent and as a result have been able to demonstrate the desirability of a combination between practical engineering and the actual selling of machinery. The company have paid a good deal of attention to hydraulic engineering and especially to centrifugal pumping machinery. One of their recent contracts is a 27,000,000 gallon installation consisting of two 20 in. pumps mounted in parallel and direct motor driven, which is said to be the largest pumping installation in British Columbia.

THE JOVIAN ORDER CO-OPERATION

On Saturday, May 3rd, a rejuvenation of the Sons of Jove was held at Cooper's Restaurant, Montreal, when 63 new members were initiated. Among the prominent candidates were: Messrs. R. F. Jones, manager, Bell Telephone Company; J. A. Baylis, engineer, Bell Telephone Company; W. H. Winter, general plant superintendent, Bell Telephone Company; R. W. Logan, general contract agent, Bell Telephone Company; A. S. Byrd, superintendent of power plants, Montreal Tramways; A. Gaboury, superintendent Montreal Tramways; J. R. Meadowcroft, manager, The Garth Company, and J. J. York, engineer, St. Lawrence Sugar Refineries. Several out-of-town Jovians were present, the total attendance being 125. A pleasant feature was the presentation of umbrellas to Messrs. Carrol, Turnley and Campbell, the members of the Membership Committee, to whose efforts the success of the Rejuvenation was largely due. Speeches were made by Mr. W. J. Doherty, statesman-at-large, and Mr. James Bennett, statesman for the province.

Another Rejuvenation is planned for the near future, to accommodate a number of those interested in the electrical industry whose applications for membership did not reach the committee in time for consideration on this occasion.

Trade Publications

J-M Products—Folder issued by the H. W. Johns-Manville Company, containing a list of their many asbestos, magnesia and electrical products. A detachable post card forms part of the folder, by the use of which the customers' wants may be made known.

Car Heating—Catalogue issued by the Parker Car Heating Company of Detroit, Mich., and London, Ont., descriptive of the Parker Anti-freezing and hot water system of railway car heating by steam. The catalogue is well illustrated and represents an interesting treatise on the subject.

Sub-Station Data Sheet.—The Delta-Star Electric Company, Chicago, are distributing a data sheet showing the cost per kw. of sub-station equipment for commercial voltages from 13,200 to 33,000 volts. This data sheet will be of service to managers called upon to make quick estimates.

Electrical Slide Rule—A pamphlet issued by Keuffel & Esser Company, New York, describing the Roylance Electrical Slide Rule. The Roylance is a modification of the regular Mannheim Slide Rule having in addition, a series of scales or gauge marks by means of which the different properties of copper wire such as size, resistivity, weight, etc., may be determined without the use of tables. Other special features are embodied in this rule.

Current News and Notes

Armstrong, B.C.

A 200 h.p. Diesel engine and 150 kw. generator have just been placed in operation by the municipality. The plant was installed by Mather, Yuill & Company. The original system in Armstrong consisted of a small Pelton water wheel driving a 100 kw. C.G.E. 3-phase, 60-cycle generator. 32 candle power carbon lamps are used on the streets. The new generator is the Swedish General Electric type.

Aurora, Ont.

A by-law will be submitted to the electorate early in June authorizing the town council to close a contract with the Toronto and York Radial Railway Company for the supply of energy necessary to feed the municipal light and power lines.

Brandon, Man.

Further debentures to the amount of $100,000 will be issued to complete the construction of the street railway system. This will bring the total of debentures issued for this purpose to $400,000. 6½ miles of track have already been laid and it is proposed to add two more miles.

Two of the street cars for the municipal street railway system which are being assembled in Winnipeg are expected to arrive in Brandon some time during the month of May.

By-laws will be submitted in the near future, authorizing the expenditure of $150,000 for street railway extensions and $26,618 for street lighting equipment.

Brantford, Ont.

There is a movement towards the purchase, by the municipality, of the privately owned railway system here.

Brockville, Ont.

The Bell Telephone Company will probably build a new exchange here during the year. The increase in the number of telephones in the last three years has been very marked, as is indicated by the following figures: In 1909 there were 465 telephones, in 1911, 525, and at the present time, 664.

Calgary, Alta.

The Calgary Water Power Company are installing two 150 h.p. turbines manufactured by the William Hamilton Company of Peterboro.

The Canadian Vickers, Limited, are at present installing, for the municipality, a 2500 kw. 3-phase, 2300 volt, 60-cycle, 1800 r.p.m. generator to be driven by a Bellis & Morcom turbine. The generator is the Vickers, revolving field, self-ventilating type.

The Bonness Investment Co. of Calgary will receive tenders up to May 31, for two a.c. generators, exciters, a spare motor-driven exciter, six panel switchboard, tungsten lighting system, transmission lines and underground cable. The generators will be driven by two vertical multi-cylinder internal combustion engines.

Chatham, Ont.

The Hydro-electric Power Commission of Ontario has submitted rates to the city of Chatham for the supply of 1200 h.p. at 13,200 volts. The estimated cost of a power and lighting distribution system including sub-station building and equipment and the necessary 13,200 volt line from the Commission's transforming station is $67,308; cost of multiple street lighting system including a certain amount of underground work with the necesary lighting standards, $14,264; engineering and contingencies, $8,157; total, $89,729.

Dawson, Man.

The power house of the Dawson Electric Light & Power Company is reported to have been completely destroyed by fire.

Dryden, Ont.

The municipality of the town of Dryden has purchased a water power property in the township of Wainwright.

A by-law was carried on May 3, authorizing the establishment of a telephone system in this town.

Edmonton, Alta.

It is reported that arrangements have been made by the directors of the Edmonton, Stony Plain and Wabamun Electric Railway Company to commence the construction of their road starting at the western city limits of Edmonton. This company has a charter for operating a line between Edmonton and Wabamun, a distance of 45 miles.

The North Edmonton Civic Association is urging an extension of the municipal street railway system along the Fort Saskatchewan trail through North Edmonton to the Belmont school. It is proposed to operate this extension with storage batteries which can be charged during the early morning hours when the load on the municipal plant is a minimum.

At a recent meeting of the city council, a number of aldermen expressed their dissatisfaction with the financial progress of the street railway system and the following resolution was carried. "That the city commissioners report as to why the street railway is not paying and what they propose to do to make it pay. And that they be asked to remedy the acute traffic conditions by putting on more cars during the noon and evening hours; and that they be asked, if possible, to have the cars run faster."

Englehart, Ont.

On May 4th, the entire business section of the town of Englehart was wiped out by fire including the Englehart-Charlton Power Company.

Estevan, Sask.

The municipal generating plant at present consists of a 125 kw. 60-cycle, 3-phase, 2250 volt steam engine driven Canadian Westinghouse generator. The municipality contemplates doubling the plant capacity in the near future.

Ethelton, Sask.

The Ethelton Telephone Company has applied for incorporation and will require materials of all kinds, poles excepted.

Fernie, B.C.

Three miles of additional pole line will be constructed through the residential districts. The city's electrical requirements will also include automatic voltage regulators and a switchboard integrating wattmeter.

Fort William, Ont.

It is considered likely that more rolling stock will have to be purchased in the near future. Recently an order was placed with the Ottawa Car Company for twelve cars, four of which have been received.

The city council has awarded the contract for 7,000 feet of 18 in. cast iron pipe to the Canadian Iron Corporation, Limited, of this city, The Canadian General Electric Company have been awarded the contract for a 500 kw. motor-generator set.

Galt, Ont.

The Hydro-electric System is growing very rapidly, having increased from 456 services in June, 1911, to 1,200 at the

present time. Power has grown during the same time from a connected load of 20 h.p. to one of 830 h.p.

Gore Bay, Ont.

The Manitoulin Island Rural Telephone Company are increasing their capital stock from $2,000 to $7,000 and will extend their line through a number of townships.

Greensville, Ont.

Plans are being prepared for the extension of the Dundas hydro-electric system to this place.

Grimsby, Ont.

The Grimsby Electric Car Company have purchased a site here, and contemplate the erection of a $25,000 factory.

Hagersville, Ont.

The Hydro-electric Power Commission of Ontario are building a small transformer station here in which they will install, about 300 h.p. capacity in Westinghouse transformers.

Halifax, N.S.

The railways committee of the Nova Scotia legislature has reported favorably on the bill which enables the Halifax Tramway Company to increase its capital to $5,000,000. At the same time the city of Halifax bill giving power to submit the question of municipal ownership to the citizens was thrown out. Following this action the mayor called a public open air meeting of protest.

Hamilton, Ont.

Tenders are received up to May 14, for three 500 kw. transformers with switching equipment.

Tenders have been called by the municipal electrical department for 700,000 ft. of underground conduits.

It is expected that the plans of the underground conduit system will be approved about the first of June, and that work will commence immediately thereafter.

The city has two gangs grading the base line east of Irondale preparatory to the laying of rails along this street by the local street railway company. It is hoped to have a street car service between Irondale and Kenilworth avenue some time during the early summer.

Kamloops, B.C.

Tenders will be received up to June 12, by DuCane, Dutcher & Company, Vancouver, for water wheels, generators, switching equipment, etc., for the new plant being installed here.

Kenora, Ont.

The Keewatin Power Company is reported to have been taken over by Mr. Backus of Fort Francis fame. It is further understood that if the purchase of certain timber limits now under construction is completed, a large power development will be carried out at this point. 9,000 h.p. is mentioned which would provide sufficient power for a 100-ton pulp mill.

Kingston, Ont.

An estimate has been submitted by the Hydro-electric Power Commission on the cost of an underground conduit system for the down town section. The question of submitting a by-law to the people to cover the expense of this work is being considered.

Lachine, P.Q.

Tenders will be received up to May 12, for material for an electric lighting system in this town. V. H. Dupont is engineer-in-charge.

La Salle, P.Q.

The town of LaSalle, P.Q., has granted a lighting franchise to the Montreal Light, Heat and Power Company.

Lethbridge, Alta.

Line extensions to the cost of approximately $10,000 will be required in the near future.

London, Ont.

Following a rate war between the London Electric Company and the city hydro-electric department, the lighting rate to the different churches has been reduced to 3c per kw. hour.

The Court of Appeal has given judgment in favor of the right of the London & Lake Erie Transportation Company to operate its cars on Sunday. This is an appeal from a recent finding of Chancellor Boyd, which was unfavorable to the railway company.

Long Reach, N.B.

The Kingston Peninsula Telephone Company, Limited, has been incorporated to build and operate a telephone system in the county of Kings, N.B.

Medicine Hat, Alta.

A vote will be taken on May 22, authorizing the council to sign a franchise agreement with the Montreal Engineering Company for the installation of a street railway system in Medicine Hat. The agreement gives the company a 20-year franchise renewable every five years. The company agree to commence work within three months from the final passing of the by-law and to finish three miles of railway within nine months, a further three miles within twelve months and a further three miles within twenty months; the whole provided the necessary material can be obtained in time.

Montreal, P.Q.

The American Light, Heat & Power Company of Canada, Limited, has been incorporated.

La Societe d'Eclairage et d'Energie Electrique du Saguenay, Chicoutimi, has been incorporated in Quebec with a capital of $3,000,000.

Tenders will be received after May 14, for wire and cable to the value of approximately $100,000, to be used in the underground installations.

The Montreal sales offices of Canadian Allis-Chalmers, Limited, have been removed from the Canadian Express building to 162 St. Antoine street.

At the Angus shops of the C. P. R., it is estimated that twenty or more electric motors ranging in capacity from 5 to 50 h.p. will be required in the near future.

The business of Mr. W. N. Dietrich, electrical contractor and engineer, Montreal, has been incorporated under the name of Dietrich, Limited, with a capital of $50,000.

By voluntarily increasing the pay of the motormen and conductors one cent per hour, the Montreal Tramways Company will add over $100,000 per annum to the wages bill.

The Montreal Light, Heat and Power Company propose to again reduce the price of electric light, although the directors have not yet decided on the amount. The present price is 7c per kilowatt hour.

Two Montreal electric companies have been granted Federal charters—Fred Thomson Company, Limited, with a capital of $100,000, and the Electric Repair & Contracting Company, Limited, with a capital of $50,000.

At the recent annual meeting of the Maritime Coal, Railway and Power Company, Limited, the president reported that contemplated extensions during the coming year would include enlargements to the power plant at Chignecto and the electrification of the colliery plant at Joggins Mines.

Nanaimo, B.C.

The Nanaimo Electric Light, Power & Heating Company, Limited, expect to commence running a day load this autumn.

Newmarket, Ont.

It has been arranged that the Hon. Adam Beck will address the rate payers here on May 22 and explain the point

of view of the Hydro-electric Commission. A vote takes place on May 30, as to whether a contract shall be made with the Toronto and York Radial Railway Company, or with the Hydro Commission.

Niagara Falls, Ont.

The transformer house of the Ramapo Iron Works was recently destroyed by fire.

North Battleford, Sask.

The installation has just been completed of a Bellis & Morcom, three-crank, compound, 750 h.p., engine and a 600 kw. Canadian Westinghouse generator. Additions to the power house costing approximately $11,000 are at present under construction.

North Bay, Ont.

An organization known as the United Board of Trade of New Ontario has been formed to include representatives from Sudbury, Sault Ste. Marie, North Bay, Sturgeon Falls, Callender, Blind River and Thessalon. The organization proposes to confer with the Hydro-electric Power Commission of Ontario in the matter of water power developments in the North land.

Norwood, Ont.

It is the intention of Mr. W. C. Harrison, owner of the Norwood electric light plant, to increase his generator capacity by the addition of a 50 or 60 kw. generator some time within the present year.

Ottawa, Ont.

The railway committee has approved a bill providing for the construction of an electric line from Brantford to Galt, passing through the townships of Brantford, Lancaster, Beverly, South Dumfries and North Dumfries. This is an extension of the system of the Brantford and Hamilton Electric Railway Company.

Outremont, P.Q.

The Outremont, P.Q., Town Council have decided to carry out the construction of underground conduits on the principal streets of the town. The scheme has been drawn up by Prof. L. A. Herdt, of McGill University, after consultation with the Bell Telephone Company. The work will be under the supervision of Prof. Herdt, but half of the cost will be borne by the telephone company, who will own a portion of the system. The conduits will be constructed to allow separate conduits for the company and for the town, with a dividing wall as common property. The work is to be done as soon as possible, as the company will soon have a new exchange ready for business in this district. The cost is estimated at $100,000, the work being let by tender. The conduits will be built on one side of the road.

Peterboro, Ont.

It is understood the Hydro-electric Power Commission will report against any extensive underground distribution system in the city of Peterboro.

Pointe-aux-Trembles, P.Q.

On conditoin that five cent fares are given, the council of Pointe-aux-Trembles, P.Q., will grant a franchise for forty years to the Montreal Tramways Company. The agreement is subject to ratification by the Provincial Legislature.

Port Arthur, Ont.

Tenders will be received up to May 19, for three motor-driven centrifugal pumps, 2,000 gallons capacity, with necessary auxiliary equipment.

Port Dover, Ont.

A by-law was recently passed authorizing the construction of a municipal telephone system at an expense of $40,000.

Prince Rupert, B.C.

A by-law for the installation of a complete new distribution system will be voted on in the near future.

Quebec, P.Q.

The Dorchester Electric Company have been awarded a contract for the lighting of Battlefields Park. 78 standards will be required in all, 34 carrying a single 250 candle power tungsten and 44 carrying a group of tungstens. All the wiring will be underground.

Tenders are being called for the construction of a new dry dock at Levis. For emptying the dock, three motor operated centrifugal pumps each having a capacity of 60,000 gals. per minute will be used. The current will be furnished by three steam turbo-generators of approximately 500 h.p. capacity each. These will supply power to the motors operating the pumps and for motors used for other purposes in connection with the operation of the dry dock. The total cost of the dock is estimated at anywhere between $4,000,000 and $5,000,000.

Revelstoke, B.C.

Contemplated additions to the Municipal light and power system include 1½ miles of 3-phase transmission line, a 1400 h.p. water turbine, a 750 kv.a. generator, a Tirrill regulator and switchboards, as well as a quantity of tungsten street lighting equipment.

Saskatoon, Sask.

An order has been placed with the Preston Car & Coach Company for six double truck cars for use on the Saskatoon Municipal Railway System. This order will be duplicated if the by-law covering the extra cost is passed by the rate payers. A number of extensions to the system are planned for the present year.

The Gratias Land Company have made an offer of a $5,000 cash contribution towards the construction of an extension to the present May Fair route. The extension suggested would be about 1¼ miles and is calculated to cost $16,000. The Land Company also agree to erect 150 workingmens' homes which they will rent at a reasonable figure.

South Edmonton, Alta.

The Leather & Shoe Company contemplate the installation of an isolated plant to supply light and power in their factory.

St. John, N.B.

On May 8th the International St. John River Commission resumed their sittings to take further evidence on the question of the effect of a hydro-electric plant at Pokick Falls on the navigation of the St. John River. It is understood that a report will be made to the government on the whole situation during the coming summer.

St. Thomas, Ont.

Street railway returns for the month of April totalled $1,430, as against $1,113 a year ago. The number of passengers carried was 38,257, as against 31,202 during the same period last year.

Strassburg, Sask.

Tenders are called until May 20, for an electric lighting plant equipment.

Sydney, N.S.

The Cape Breton Electric Company, following a record year in earnings, have increased the dividend rate on the common stock to 6 per cent.

The Pas, Sask.

Tenders will be received to May 20 for supply and delivery of two crude-oil engines and two generators with exciters, switching, and all necessary auxilary equipment. Murphy & Underwood, Saskatoon, are consulting engineers.

Three Rivers, P.Q.

La Compagnie Hydraulique de Saint Paulin Limited, has been incorporated with head office Saint Paulin, with power to develop water falls and operate flour, grain, lumber mills, etc.

Toronto, Ont.

A bill for the establishment of a hydro-electric system serving sections of New York State and operated according to plans similar to those adopted by the Hydro-electric Power Commission of Ontario has been passed.

The Bell Telephone Company have opened a new exchange on Logan avenue in the eastern part of the city to be known as the Gerrard exchange. The switchboard has a present capacity of 2,000 telephones but is planned for an ultimate capacity of 10,000 lines.

The International Light & Power Company which was recently incorporated at Ottawa with a capitalization of $10,000,000 turns out to have been formed for the purpose of buying securities of public utilities operating in South America. It does not appear that there is any intention on the part of the company of purchasing Canadian public utilities.

The Bell Telephone Company recently made application to the Dominion Railway Board for an order to discontinue the interchange of long distance service with a number of independent telephone companies. Council for the Bell Company claimed that the independent companies were cutting into the Bell business. The evidence was taken recently in Toronto and the Board reserved judgment.

Vancouver, B.C.

The Silver River Power Company has been incorporated with head office, Vancouver, and given the usual wide powers of acquiring and developing water powers and distributing electrical energy, etc.

Victoria, B.C.

The British Columbia Electric Railway Company have at present under erection an additional 8,000 kw. hydro-electric unit at their Jordan River plant.

Walkerton, Ont.

The Walkerton Electric Light & Power Company, Limited, are at present building a new dam and power house which it is expected will be complete in June of the present year.

Weyburn, Sask.

The town of Weyburn, are at present installing two 266 h.p. water tube boilers. In the near future they will add a 500 kw. steam driven generating set.

Windsor, Ont.

A contract was recently awarded by the town council to R. E. T. Pringle, Toronto, for 125 ornamental lamp standards.

Winnipeg, Man.

Plans are drawn for the ornamental street light extension on Main street north, from the subway to the northern city limits.

The following wage scale has been agreed to between the Winnipeg Electric Railway Company and its employees: First six months, 25c per hour; second six months, 27c; second year, 28c; third year, 31c; fourth and following years, 34c.

The Woodstock and Northampton Telephone Company, Limited, has been incorporated to carry on a general telephone business in the parishes of Northampton and Woodstock and the town of Woodstock, and eleswhere in the county of Carleton.

Yorkton, Sask.

Tenders have been called for the erection of a new power house building.

MOONLIGHT SCHEDULE FOR JUNE, 1913

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
May 1	7 50	Jun. 2	3 50	8 00
2	7 50	3	3 50	8 00
3	7 50	4	3 50	8 00
4	7 50	5	3 50	8 00
5	7 50	6	3 50	8 00
6	7 50	7	3 50	8 00
7	7 50	8	3 50	8 00
8	7 50	9	3 50	8 00
9	7 50	10	3 50	8 00
10	10 40	11	3 50	5 10
11	11 10	12	3 50	4 40
12	11 30	13	3 50	4 20
13	11 50	14	3 50	4 00
15	0 20	15	3 50	3 30
16	0 50	16	3 50	3 00
17	1 30	17	3 50	2 20
18	No Light	18	No Light	
19	8 00	19	10 30	2 30
20	8 00	20	11 10	3 10
21	8 00	21	11 40	3 40
22	8 00	23	0 10	4 10
23	8 00	24	0 30	4 30
24	8 00	25	0 50	4 50
25	8 00	26	1 10	5 10
26	8 00	27	1 30	5 30
27	8 00	28	1 50	5 50
28	8 00	29	2 20	6 10
29	8 00	30	2 40	6 40
30	8 00	July 1	3 10	7 40

Total Hours............158 20

Condensed Department

Nernst Lamp Scrap Parts

We purchase for cash Heater Tubes, Glower Ends, Burners and all kinds of Scrap Gold, Silver and Platinum. National Refining Co., Ltd., 81 Peter Street, Toronto. 10-12-14-16-18-20

FOR SALE

One Westinghouse type C. 100 h.p., 2000 volt, 25 cycle, induction motor, 480 r.p.m., with starting panel complete.

One General Electric type A.M. form B., 2200 volt generator, 32.6 amp., 60 cycle, 900 r.p.m., with exciter and combined generator and exciter panel complete.

First class condition, crated for shipment, Welland, Ont. For particulars apply to Hydro-Electric Power Commission of Ontário, Continental Life Building, Toronto. 9 10

FOR SALE

Tenders wanted for purchase in whole or in part of the following apparatus:—

1 20 h.p. 220 volt, 60 cycle, C.G.E. Motor, complete.
1 5 h.p., 220 volt, 60 cycle Westinghouse Motor.
2 5 h.p., 110 volt, 60 cycle, Westinghouse Motors.
1 2 h.p., 110 volt, 60 cycle Westinghouse motor.
1 Goldie McCulloch Wheelock Engine, 125 h.p., 20 x 50 x 16 x 50.
1 Laurie Corliss Engine, 90 h.p., 13 x 30.
2 Northey condensers and pumps, 8 x 12 x 12.
36 ft. 4-in. line shafting, complete with vertical shaft hangers and boxes and 2 friction clutches.
2 belt tighteners.
1 pulley, 46 x 23½.
1 pulley, 30 x 22.
2 pulleys, 19½ x 17.
1 pulley, 17½ x 72.
1 pulley, 5 x 28.
79 ft. 2-ply, 17½-in. leather belt.
61 ft. 2-ply, 16-in. leather belt.
82 ft. 19½-in. leather belt.

Approximately 100 ft. 4-in. steam pipe with valves and fittings complete.

All the above apparatus in first class shape but has been discarded owing to the introduction of Hydro-electric Power and may be seen at the Pumping Station, St. Mary's, Ontario.

H. M. MILLER,
Sec. W. L. & H. Commission.
10 11 St. Marys, Ont.

FOR SALE

100 H.P. Boiler and Engine, Watrous Engine Co., Brantford, Ont. Dynamo, Allis-Chalmer, Bullock, Montreal. Apply Town Clerk, Milton, Ont. 9-10

Wanted

WANTED—Second-hand generators. 1—60 kw., 1—150 kw., 1—120 kw., 1—200 kw., 3 phase, 60 cycle, 2200 volt machines, for belt drive, must be in good condition and by some standard maker. Box 780, Electrical News, Toronto, Ont. 9-12

A large firm manufacturing carbon brushes for all kinds of service desires good electrical or supply firm or else good salesmen to represent them in various parts of Canada. Apply Box 774, Electrical News, Toronto. 9-10

Wanted

Large United States firm manufacturing the best carbolineum wood preserver on the market is considering the advisability of making an arrangement with some concern in Canada to handle their product on a royalty basis. For particulars address Box 784, Electrical News, Toronto, Ont. 9-10

CITY OF REGINA

Sealed tenders, registered and clearly marked on the outside of the envelope, "Tender for Power House Equipment," and addressed to the City Commissioners at Regina, will be received up until noon of **May 15th, 1913**, for the supply of:—

One pair vertical boiler feed pumps; each pump's capacity to be 7,500 imperial gallons per hour.

One combined open heater and meter, capable of handling 125,000 lbs. feed water per hour.

Copies of specifications may be had from Mr. E. W. Bull, Superintendent of Light and Power, Regina, Sask. A marked cheque for five per cent. of the amount of bid must accompany each tender.

The City Commissioners reserve the right to reject any or all tenders. 9-10

Agents Wanted

WANTED—Reliable agents to handle established line of Instruments and Transformers throughout the Canadian territory. Box 785, Electrical News, Toronto, Ont. 10

Situations Wanted

Engineer, 10 years experience manufacturing and operating, seeks post as superintendent, chief operator, or local superintendent of Hydro-electric power plant. Held similar positions. Vacant June 23. Box 792, Electrical News, Toronto, Ont. 10

Technical graduate, familiar with plant and switchboard design, test and manufacturing of electrical apparatus, seeks position connected with the design or construction of hydro-electric power plant, around Montreal preferred. Would like to start as designing draughtsman. Has also experience in surveying and underground construction. Speaks English and French. Best of references. Apply Box 794, Electrical News, Toronto, Ont.

Situations Vacant

Hydro-Electric operator wanted to take charge of eight hour shift, $75.00 a month. Box 777, Electrical News, Toronto, Ont. 9-10

WANTED—Man with Engineer's License, as helper in Power House. Steady employment. State experience and salary expected. Box 768, Electrical News, Toronto, Ont. 9-10

WANTED—Salesman for electric wire and cable lines. College graduate with experience as salesman preferred. Write fully giving experience, training, age and references. Box 786, Electrical News, Toronto, Ont. 10

WANTED—Recent college graduate, technical course, preferably electrical, for office position, including correspondence. Write full particulars as to training business experience, age and references. Box 787, Electrical News, Toronto, Ont. 10

Electrical News

Generation, Transmission and Application of Electricity

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The Strike Epidemic

The present epidemic of strikes is emphasizing more than ever the apparent inadequacy of our laws in dealing with a matter which is of the most vital importance to the general public. It is unreasonable beyond measure that any mere handful of men should have it in their power to cause even a physical inconvenience to a whole community representing often hundreds of thousands of men, women and children. It is equally unreasonable that they should have the power to tie up as they do the commercial life of a big city or for that matter of a whole province. In most such cases both the personal and financial losses are sustained by persons in no way connected with and only indirectly interested in the questions at issue. Our laws are unquestionably inadequate or their administration poorly carried out if they cannot ensure continuity of service as well during the time in which such matters are at issue between the two parties concerned, as at any other time. The contract between the employer and employee in an electric railway system or an electric light system or on a steam road, should be as binding as any other contract and should include such conditions for the termination of this contract as would make it impossible for either to force the hand of the other by "hold-up" proceedings, such as usually characterize strikes. The whole basis on which the system of strikes appears to be built is that the greater inconvenience they can cause their employers and the general public, the greater is their chance of success. A more selfish, unreasonable, untenable point of view cannot well be conceived. This is quite aside from the merits of the demands made by the men which are often just, but the methods followed in attaining their rights appear to be entirely incompatible with modern civilization.

But the phase of the question that represents absolutely a return to primeval barbarism is that a body of striking workmen should be permitted to use force and if necessary shed blood in preventing anyone else from carrying on the service they themselves refuse to perform. For offences of this kind the laws cannot be too specific nor too strictly enforced. While the recent fatality in one of our cities must be regretted by all, it will be recognized that it resulted directly from a violation of every modern conception of justice and personal rights.

Electrification Costs

A paper printed elsewhere in this issue throws considerable light on the vexed question of the cost of electrification of steam roads and the probability of these roads becoming a paying proposition under electric operation. The article takes its data from a 467 mile road in the western United States, where the conditions of construction and operation are judged to be about normal. It is calculated that the total cost of electrification of a line of this length is slightly under $10,000,000, which works out to between $21,000 and $22,000 per mile. Certain allowance, however, could be made for the steam equipment which brings the total in this case down to slightly under $8,000,000, or approximately $17,000 per mile. It is calculated that the annual saving effected by the change from steam to electric power is slightly under $1,000,000, which works out to approximately 12 per cent. on the original investment. On the supposition that money can be borrowed for half this amount, this looks like a good business proposition. The question, however, hinges very largely on the two balancing items of (1) heavy expenditures involved for initial equipment and (2) increase in net earnings. While the former may be more or less constant, the latter will depend largely on local conditions and can only be determined after a most careful investigation of each individual case.

Calgary's Power Problems

The power situation in Calgary is especially interesting on account of the wide range of choice of prime movers available at that point. There is hydro-electric power obtainable in large quantities; coal of good quality is mined at no great distance; natural gas is obtainable at a reasonable rate which can be used either for firing the boilers or in a combustion engine; and there is any combination of these. The report by Mr. R. A. Ross, which appears on another page in this issue, must of necessity, therefore, cover a wide range of interesting developments for electrical men.

It would generally be considered that Calgary in buying power at $26 is in a particularly fortunate position, but the report is able to offer something still more promising. The figures show that, on the supposition that Calgary in ten years will have a population of 200,000 people and will require 45,000 kws. of energy, this can be manufactured by a coal-fired steam plant for .74c. per kw. With a gas fired steam plant, however, the cost figures out at .62, and with a gas engine plant at .55. No combination of water power with either of these three was able to show a lower cost. In spite of the lower operating costs of gas plants, however, other equipment, for different reasons, is chosen. It is estimated, however, that further investigations into the possibility of gas driven engines would be justifiable. In the meantime steam turbines with gas fired boilers give promise of the best results.

Special Telephone Articles

We commence in this issue a series of articles on the most approved methods of testing out telephone and telegraph lines in time of trouble or with a view to avoiding trouble, by Mr. T. H. Nicholson. Mr. Nicholson is a man who has been schooled in every stage of the work he describes, and we commend his articles to the careful consideration of all our readers who are interested in telephone and telegraph matters. They will be found applicable to equipments of any size and to the apparatus of every manufacture.

Electricity in New C.P.R. Building

An isolated generating plant—Motors and motor generators for many purposes—Wiring very complete and modern

The electrical equipments of Toronto's tallest and one of her handsomest buildings, the new Canadian Pacific Railway head office building at the corner of King and Yonge streets, possess many features of general interest, as well as a number that are quite unusual and novel.

The building comprises eighteen storeys including a basement and sub-basement. The ground floor and the second floor as well as the fourteenth and fifteenth storeys will be utilized for the C. P. R. business offices while the fourteenth and fifteenth floors will contain almost entirely, the company's telegraph equipment. The intervening storeys will be used for general offices, most of which are already contracted for.

Power and light will be supplied throughout the building by a private plant placed in the sub-basement. There are three generating units, steam engine driven, of capacities 50 kw., 75 kw., and 100 kw., respectively. All these generators are three-wire, 250 volt, direct current, with balancing coils. The generating equipment is divided into three units in this way to make it more flexible, as it will doubtless often happen that even a small unit will be sufficient to carry both the light and power load. The engines were manufactured and installed by the Robb Engineering Company and the generators by the Allis-Chalmers-Bullock.

The argument which probably carried the greatest weight in deciding whether to install an isolated plant in this building was that the steam boilers which, of course, had to be installed for heating purposes, would also operate of necessity during the summer to take care of the elevator load as the elevators are driven by steam operated pumps. The elevators are of hydraulic type, the shaft of one of them which runs to the sub-basement being sunk approximately 250 ft. below the ground level.

The switchboard controlling the power and light was manufactured and installed by the Northern Electric & Manufacturing Company and is shown herewith, both front and rear. There are five panels consisting of three generator panels, one power panel and one lighting plant. The board is supplied, as shown to the extreme left of the figure, with two volt meters and the power panels with six ammeters. These are all of the Weston type. The power and light panels carry three watt meters, Sangamo type. The circuit breakers shown on the three generator panels are I. T. E. manufacture. At the extreme lower right hand corner will be seen a double throw switch which was installed in case it should be deemed advisable to connect up with an outside source of power for emergency purposes or other reason.

A large number of small d.c. motors are used for various purposes throughout the building. For ventilation there are three 6 h.p. motors, one 10 h.p., one 7 h.p. and one 3 h.p. These are C. G. E. motors and are placed three on the roof in the corner towers and three in the basement. Provision has also been made for an air washing machine.

In addition to the ventilator motors there is a 5 h.p. unit installed in the sub-basement to operate the coal conveyor which runs along an elevated track above the front of the boilers. In this connection there is also a one-half h.p. motor which is used to agitate the coal and make it fall freely.

The building will be cleaned throughout by the vacuum process. An American Rotary Valve stationary cleaner has been installed in the basement and will be operated by a 15 h.p. Jenney motor. This motor is controlled only from the basement through a suitable resistance. Two Sump pumps driven respectively by 5 h.p. and two 2 h.p. motors have also been installed in the sub-basement.

A 3 h.p. Sprague motor operates a pneumatic tube system between the floors occupied by the Canadian Pacific Railway Company. This motor does not operate except when messages are being sent, the insertion of the message in the pneumatic tube starting the motor automatically.

The motor installation further includes two small d.c. motor d.c. generator sets reducing the voltage to 20. The 20 volt current is to be used for operating the fire alarm and call bell system which have been installed throughout the building. These motor generator systems will not be required to operate all the time but will be used to keep a 10-cell storage battery of 80 amp. hour capacity charged up for this purpose. In addition to the above motor generators larger sets of various sizes and voltages will be installed for operating the telegraph instruments on the fifteenth floor. A separate board not shown in the figure will be placed on the right of the main switchboard to control the motor generators.

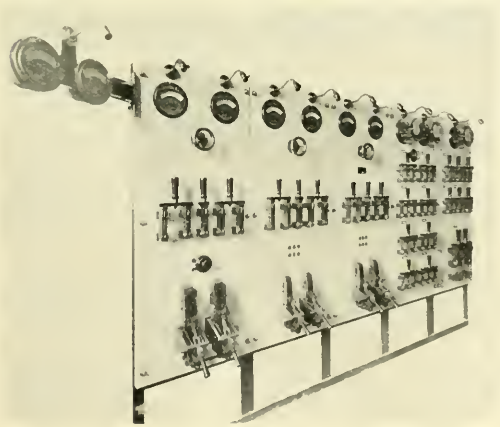
New C.P.R. head office building.

In all there will be 22 panels installed on the different floors, these being placed in a small janitor's room provided on each floor. The panels were supplied by the Mutual Electric Machine Company, Wheeling, West Virginia. These panels will be distributed as follows:—one on each floor for lighting; there will also be one panel for a 300-light sign to be installed on the roof; two panels in the basement and one in the sub-basement. The remaining panels will be for power distribution.

There is also installed on each floor a low tension box in the same room with the panels. These control telegraph and telephone circuits and current for call bells, any of which may be installed in any room in the building. At the same point is also controlled the electric clock system which is being installed by the C. P. R Company for their own use on the floors they will themselves occupy. The low tension box on each floor however, will make electric clocks available at any point if required.

All the light and power wires are run in metal conduit as are also the telegraph, telephone, clock control and call bell wires, as far as the low tension boxes. Conduit up to 3 in. in size was used, this being required for telegraph and telephone purposes. Approximately 50,000 ft. of conduit in all was used in the installation. The conduit was supplied by the Conduits Company, Limited.

Apart from the lighting on the first and second floors which the C. P. R. Company will occupy, the fixtures represent a rigid simplicity—a single chain hanging from the centre of each room which will carry one lamp only. The size of the lamps will be varied to suit the requirements of the occupants of any particular room. The ceiling lights are however, well supplemented by some 600 base receptacles designed principally for desk lighting. Fans may also be operated from these receptacles. The base receptacles were supplied chiefly by the Bryant Company, but a few are of

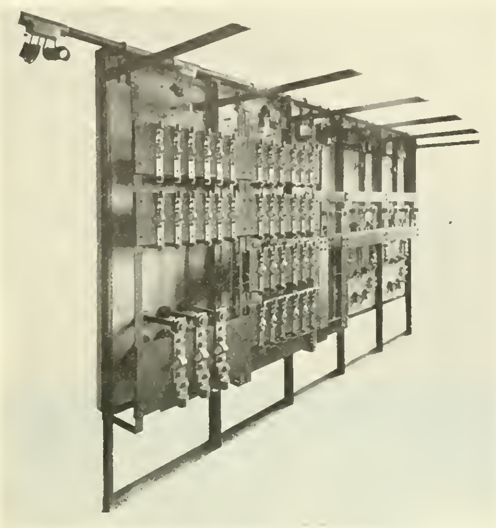


Main switchboard, C.P.R. head office building.

the H & H type. Some 50 floor receptacles have also been installed, these being supplied by the Thomas & Betts Company.

A very useful feature in connection with the installation of these base receptacles is the method of installing the base board in the various rooms. In an office building of this sort, practically every new tenant wants the outlet in a different place from the last tenant. As a result office rooms are generally very badly cut up by the electrical contractor. By overcoming this difficulty in the C. P. R. building the base board has been made in three members the centre one of which is removable being held in place by a number of wood screws. Having removed this centre board which is about 4 in. in width the wires may be brought to an outlet at any point desired in the room.

The building has been wired throughout by No. 12 wire instead of the usual No. 14 The wire was supplied by the Electric Cable Company of New York. The extra large size will guarantee not only against dangerous heating from over-



Rear of switchboard, C.P.R. head office building

load, but will have the effect of reducing the voltage drop at times of heavy load. The one-light fixtures are being supplied by the Robt. Mitchell Company of Montreal.

The lighting fixtures in the first and second floors, i.e., in the general offices of the company, will be much more pretentious though with the exception of the mezzanine along one side of the rotunda where indirect lighting units will be installed, only wall brackets will be used.

Flush type push button switches to the number of 350 will be installed. These are manufactured by the Cutter Manufacturing Company. The outlet boxes have been supplied by the Electrical Fittings Company of Toronto, and the necessary condulets, which have only been used for power distribution purposes, are being supplied by the same company.

The electric clock system will consist of eleven clocks controlled by a master clock placed on the telegraph floor. These clocks are self-winding and self-adjusting, these operations being electrically performed. The eleven units will be synchronized every hour. The clocks were supplied by the Self-winding Clock Company of New York.

Thirty-two watchmen's stations and thirty-two fire alarm break glass outlets are installed on the various floors. Each watchman's box contains a magneto which the watchman turns with his key. This makes a record, automatically, on a chart in the engine room, the time and the number of the station being both recorded. This equipment was supplied by the Holtzer-Cabot Company. At each fire alarm outlet a little metal hammer is suspended with which to break the glass cover of the outlet. By striking this hammer against a slightly protruding metal point the electrical contact is made which operates an annunciator and bell in the engine room in the sub-basement. This notifies the engineer

to set his force pumps in operation. Two coils of hose are supplied on each floor.

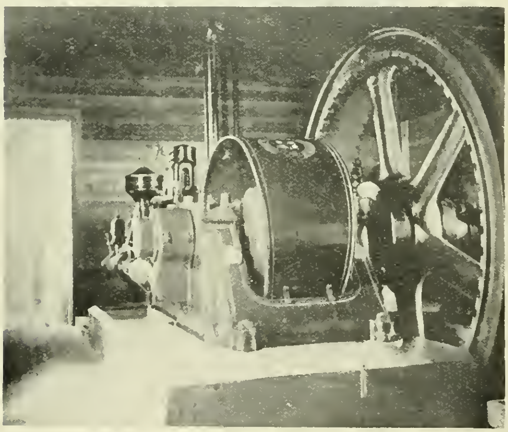
Elevators

The elevators in this building are hydraulicly operated and were installed by the Electric Signal & Supply Company. Lamp signals on each floor, of different colors, announce the approach of the elevators up or down. Lamp signals in the form of moonlights are also operated on the cars themselves by the push buttons from the various floors. That is, as soon as the elevator is signalled from any floor the moonlight is illuminated and remains so until that floor is reached, when it is automatically shut off.

The electrical installation throughout the building is in the hands of the L. H. Nielson Company of Pittsburgh, Pa., though the actual work is under the immediate charge of Mr. W. H. Hall. This same firm are also installing the electrical work in the Fort Garry Hotel, Winnipeg.

New Gas-Electric Plant in Wadena

The municipality of the town of Wadena, Sask., has quite recently completed the installation of a gas-electric light and power plant. The equipment consists of a 60 h.p. Ruston suction gas-engine (manufactured in Lincoln, Eng.), with producer, and a 30 kw. alternating current, 2300 volt, Westinghouse generator with exciter. The gas engine is of the throttle governor type, the governor acting directly on the inlet valve which is double ported, the gas passing through the top port and then mixing with the air as it passes through the second port. Ignition is make and break, current being supplied by two triplex magnetos, each connected to an electrode in the spark plug. Compressed air is used for starting the engine, a storage tank and compressor being provided. Anthracite coal, pea-size, is used in the manufacture of the gas. The producer is built for continuous operation, the ash collecting in a tank of water under the producer from which it may be removed with a scraper.



Interior view Wadena's gas-electric plant.

Before passing to the engine the gas passes through a long tank filled with coke and kept moist by a stream of water, by which means it is cleansed and cooled. No tar extracter is needed with the anthracite coal. The gas passes on from the scrubber to the expansion tank, which is filled with trays of excelsior which collect any moisture or any small amount of tar that may come over from the scrubber.

With the engine operating at full load about ½ to ¾ lbs. of coal is burned per h.p. hour. When running light the engine uses up to as high as 2 lbs. per h.p. hour. There is a very small loss during the shut-down when the coal is banked. The actual running results for the month of March showed 1.8 lbs. per h.p. hour, reckoned in actual energy delivered to the customers.

The engine is water-cooled, thermo-syphon system, 4 tanks 4 ft. x 8 ft. being used. The exhaust valve is cooled from an overhead tank, the water running to waste.

This plant was installed by the British Canadian Engineering and Supply Company, and is now being operated by Mr. T. W. H. Lockhart, who reports that it is working with entire satisfaction. Mr. Lockhart states that the engine could not run steadier and that the speed remains constant at any load.

The figure reproduced herewith shows the engine, with large fly-wheel attached for regulation purposes. The diameter of this wheel is 8 ft. 3 in., face 14 in., weight 10,000 lbs. This heavy wheel, together with a very sensitive governor makes the engine run very steadily.

The cost of the plant, including the setting of 100 poles, the street wiring with necessary transformers, 30-80 candle power tungsten street lamps, and 60-5 amp. meters, totalled $11,000, exclusive of the power house. The power house when complete will cost about $1,200. The power house is 78 ft. long, 14 ft. 6 in. wide and 12 ft. 6 in. high, and includes an office 14 ft. 6 in. x 15 ft., an engine and generator room 14 ft. 6 in. x 44 ft., the producer room 14 ft. 6 in. x 12 ft., and a coal room 14 ft. 6 in. x 9 ft. The outside is finished in clapboards with rubberoid roofing.

The street lighting consists of single bracket lamps with hood. The lamps are 80 candle power, 5.5 amp., arranged in series through a constant current transformer and regulator. The thirty lights at present in use will be extended during the present summer.

Proper Electric Garage Service

By Mr. R. MacRae

The following useful paper was recently presented before the Vehicle Association of America. Mr. MacRae is in charge of the Electric Vehicle Section of the Commonwealth Edison Company of Chicago.

Complaints are often heard about the lack of garaging facilities for electric vehicles; the poor service to be obtained in many of our public garages, and the inexperience of the men in charge of them.

While these complaints are in many cases justified, and while it is necessary to admit that there is almost unlimited room for improvement in the manner in which some of our garages are conducted, we need not be very much surprised to find that such is the case.

When we consider the highly technical character of some of the work that has to be done in an electric garage and how short a time it is since we had garages of any kind, we may rather wonder that the garage service in general is as good as it is.

Although it is an easy matter to find cause for criticism, we must not at the same time forget how much the public garages have done to bring the electric vehicle within the reach of the public, and how much of the interest that is now being taken in these vehicles is due to the work that has been done by the garages.

Without good garage service it is impossible to have good electric vehicle service, and it is now generally recognized that the full development of the electric vehicle industry can be brought about only through the agency of properly equipped public garages.

It is of the highest importance, therefore, that the ques-

tion of garages receives the attention of everyone who is interested in the success of the electric vehicle and especially the attention of the Electric Vehicle Association.

As far as methods of operation and equipment are concerned, the electric garage differs quite as much from the gasoline garage as each of them differ from the livery stable; the methods that answer all right for one will not apply at all to the others.

If it were asked what is the best possible garaging system for electric vehicles that we could have in a city like Chicago it might not be an easy matter to get the right answer; there would, no doubt, be considerable difference of opinion on the subject. It would be readily admitted, however, that such a system would be quite different from anything that we now have. It is not necessary to speculate much on this question as we are now more concerned in seeing some improvements in the garaging arrangements that we have than in discussing ideal garages.

It must not be inferred from this that we have no good garages. There are several of them, but there are so many that do not belong to this class that the urgent need for improvements cannot be disputed.

The remedies needed to bring about such improvements may be indicated by drawing attention to some of the facts of the garage situation.

The manner in which a new electric garage makes its appearance is quite often somewhat as follows:

A large building more or less suitable for the purpose is rented by someone who has decided to start an electric garage. The fact that he does not know anything about an electric vehicle does not worry him any. He is satisfied that he knows as much on the subject as some others did when they started in the business. After he has fixed up one or two charging plugs and rheostats he puts a sign in front announcing that the place is an electric garage, where storing, charging, repairing and expert battery service may be obtained. When the first customer comes in, the Central Station is asked to send a man to test the polarity of the charging wires and to show how the charging current can be regulated. Next day the proprietor of the garage, being in some doubts as to whether the vehicle was charged or not, anxiously awaits a call asking him to come to tow the vehicle in. If no such request is made and the vehicle gets back to the garage under its own power, he is satisfied that there is nothing more for him to learn about the management of an electric garage. Everything goes smoothly for a day or two and a new name is added to the list of electric vehicle experts.

Attendants Lack Knowledge

Not long since one of these ready-made experts, in claiming that his power bills were too high, argued that it was impossible for any electricity to go into a battery after it was fully charged and that it made no difference whether the charging switches were closed or open.

Another expert, who had as many as 30 cars to attend to shortly after he had opened his garage, and who was obliged to acquire his electrical knowledge rather hurriedly, was heard to remark: "You can't tell me that a slow charge is the proper thing for a lead battery; by forcing the juice in strong I can get the voltage of my batteries up in half the time that some of these other fellows take, and I can get along with half as many charging plugs."

This man sold the business out to another who had no previous experience with electric vehicles. The new man not only did not know anything about electricity, but did not think it necessary to learn anything. The garage did not prosper under his management and in a short time he lost about half of his customers. As he kept no records whatever of the amount of electricity that he was using, he was rather surprised when the monthly power bills came in to find that they were larger than the bills paid by his predecessor, who had twice as many cars to charge. Investigation showed that the boy who did the charging found it more convenient to let the current run into the batteries all night than to watch to see when each car was charged and that he sometimes used as much as 25 kilowatt hours to charge batteries that had a capacity of only half that much.

On account of such conditions as these it has been seriously maintained that it would be better for the electric vehicle industry if there were no public garages, and that better results would be obtained if each owner kept his vehicle in a private garage. Experience, however, has shown that such is not the case. If the treatment that vehicles get in public garages is sometimes bad, what happens to them in private garages is often worse.

Old stables, woodsheds, and such structures where one or two electric vehicles are sometimes found and where there are no facilities for doing anything, and no one to look after the vehicles who can tell a battery jar from an oil can, are not suitable places in which to keep electric vehicles.

When we hear that electric vehicles operated under such unfavorable conditions are a failure, we need not be surprised or discouraged—we have no right to expect anything else.

Electric Vehicle Rarely to Blame

It is seldom a failure of the electric vehicle; it is a failure of the method of operating, or rather the failure is due to a lack of any rational method of operating. Probably 75 per cent. of the so-called electric vehicle failures have been failures of this kind.

These make-shift garages, however, have shown that satisfactory service can be obtained from electric vehicles under conditions that would be prohibitive for any other type of vehicle now in use, and they have been the means of demonstrating beyond any question that an adequate garaging system is the only thing now needed to enable the electric vehicles to drive the horse-drawn vehicles entirely from our streets.

The disorderly ideas that prevail in regard to the care and operation of electric vehicles are not due to any lack of intelligence on the part of owners of vehicles and garages; they are wholly due to the fact that there are no authoritative instructions to be had on the subject. Vehicle owners are naturally anxious to give the vehicles the care that will enable them to get the best service from them, but the vehicle manufacturers have so far published scarcely anything to indicate how they would like to see the vehicles cared for. Having no definite instructions to follow, each vehicle owner is obliged to do the best he can, and the result is an amazing variety of opinions in regard to the best methods of charging and operating.

A few days ago the manager of a small garage complained that his charging apparatus was not working properly. He had four electric trucks—two of them having lead batteries, and two of them Edison batteries. When asked if he had any printed instructions or cards telling how the charging should be done, he said: "We never had a scrap of charging instructions in this barn." Another who was having troubles of the same kind was asked: "Why don't you get charging instructions from the agent who sold you the car?" and the reply was: "Those boys down there don't know anything, and even if they did, they would not tell you anything." Almost any number of such instances might be given.

The remedy for this situation, which is doing so much to retard the introduction of the electric vehicle, is not hard to find; it is simply an admission on the part of vehicle manufacturers that operating instructions are needed.

For years the main talking point of the electric vehicle salesman has been that it is not necessary to have an ex-

perienced man to operate an electric vehicle. Not long since I asked an agent if it did not take considerable time to learn how to take care of an electric vehicle, and was told that anyone could learn all about it in less than half an hour. "But the battery requires quite a lot of attention, does it not" "Why, you don't have to bother about the battery; we furnish an automatic charging apparatus, and all you have to do is to start it and the current will shut itself off when the battery is fully charged."

A visitor to our automobile show from the East told us here a few weeks ago that when questions in regard to batteries or power consumption were asked of the vehicle salesmen at the Coliseum, the answers given were outrageous, and then for fear of hitting our local pride too hard, he quickly added that conditions were no better in that respect where he came from. Some such answers, however, are the only ones that can be given as long as vehicle manufacturers think that the term "kilowatts" is too academic for everyday use.

When the question of operating instructions was taken up not long since at a meeting of the Electric Vehicle Association one of the speakers said that the best thing for an electric vehicle operator to do was to leave the vehicle intelligently alone and rely on some vehicle expert to keep it in working condition. He also said it was not customary for vehicle manufacturers to issue printed instructions for operating, but that they supplied the instructions published by the battery manufacturers. These opinions and this method of disposing of the question of instructions seemed to have the approval of the meeting, as no criticisms were offered.

Value of Full Instructions

It is evident, however, that this is a very unsatisfactory way of dealing with the situation. Nothing can be gained by giving the impression that an electric vehicle is such a mysterious piece of apparatus that it takes a man of more than average intelligence to get a working knowledge of how it is constructed, and to ask the battery manufacturers to supply all operating instructions and in this way assume the responsibility for the operation of any and every kind of vehicle under all sorts of conditions is clearly unreasonable.

The first thing that the purchaser of an electric vehicle has to think about is electric power, and it is for the purpose of getting power that he applies to the electric garage. It is obvious, therefore, that the garage man should under stand thoroughly how to measure electric power and how to use it economically, and that the man who gets the power should know what to ask for.

On the subject of power, scarcely anything is said in the literature now given out by the vehicle manufacturers and a lot of talk about foolproof apparatus has created the impression that it is not necessary to know anything about it.

While the attention necessary to keep an electric vehicle in good working order is very small compared to that which is required for vehicles using other power, the electric vehicle is still a long way from being foolproof and is likely to remain so, no matter how much it is improved or how many automatic devices are attached to it. When this fact is fully recognized by the vehicle manufacturers and is made clear to the purchaser of a vehicle at the time a sale is made, it is quite certain that we will hear less about neglected batteries and unusually large power bills, and that the service in our garages will be brought much nearer to what might be called an ideal standard.

Lignite Coal for Power Purposes

Possible advantages of central power plants at Lignite Fields —Overcoming loss due to fuel transportation

Lignite coal disintegrates rapidly and does not possess a very high calorific value. Consequently, it is seldom economically possible to ship it for long distances, to be used for developing power. At the same time, there are excellent reasons for believing that central power plants, situated at the lignite areas in different parts of Western Canada, could economically generate and transmit power to towns and cities within a considerable radius of the fields.

The following table gives a comparison of fixed charges involved in power transmission and fixed charges on fuel transportation. The figures relative to freight rates on coal from the mines to the point of consumption have been calculated from Canadian freight tariffs. In Western Canada, the average freight rate on coal per ton-mile for a 100-mile haul is a trifle over 15 mills.

It will be noted from the table, that the annual loss by transportation of fuel from the mines to the point of consumption (100 miles) varies from $61,945 for a plant of 5,000 kw. capacity, to $346,674 for one of 20,000 kw. capacity. The conditions assumed in this table, however, are for a constant power load for 24 hours a day, and the comparison would not be as favourable if the load was only on for a portion of the day.

In any case, the figures are sufficiently startling to warrant an investigation being made as to the possibilities of central power plants at the lignite fields in Saskatchewan as compared with the present method of hauling bituminous coal long distances by rail to the markets in central Alberta and Saskatchewan.

Comparison of Fixed Charges Involved in Power Transmission and Freight Charges of Fuel Transportation

Power Station at Mines. Distance, 100 Miles from Point of Consumption. Freight, $0.015 Per Ton Mile. Coal, 4.0 lbs. per kw.h.

	Central Station Capacity		
Details of Construction and Losses	5,000 kw.	10,000 kw.	20,000 kw.
Right of way; Cost per 100 miles 50 feet wide.	$60,000 at 5% $ 3,000	$60,000 at 5% $ 3,000	$60,000 at 5% $ 3,000
Steel tower const'n. Cost per 100 miles; Twin circuit towers not including copper	$332,200 at 9% $29,898	$322,200 at 9% $29,898	$322,200 at 9% $29,898
Conductor; Cost for most economic line, Copper at 14c lb.	$70,000 at 6% $4,200	$140,000 at 6% $8,400	$280,000 at 6% $16,800
Kw.hr. loss on line; Cost of $0.003 per kw.hr.	$4,857	$9,714	$19,428
Transformers; Equal capacity at each end of line to carry load; Cost $15.00 per kw.	$150,000 at 15% $22,500	$300,000 at 15% $45,000	$600,000 at 15% $90,000
Total of fixed charges and losses	$64,455	$96,012	$159,126
Freight charges one year's coal supply	$126,450	$252,900	$505,800
Loss by transportation of fuel	$61,945	$156,788	$346,674

The Power Situation in a Western City

A choice of many power sources Steam turbines with gas-fired boilers are favored—The gas-engine very economical.

The phenomenal development of the City of Calgary threatens to result in an acute situation with regard to adequate supply of power for present and future requirement. The Board of Commissioners however, have been quick to realize the needs of their rapidly growing city and some months ago engaged the firm of R. A. Ross & Company, consulting engineers, Montreal, to make a report on the general situation. This report was recently presented and inasmuch as it represents, in a very definite manner, a most interesting phase in western power development, we are pleased to be able to reproduce it in full. The report is as follows:

Acting under your instructions, we have investigated and beg to report herein upon the power question in its various phases in the city of Calgary.

We were instructed not only to investigate and report upon the costs of power to be obtained from several sources, but also upon the power demands of the city, and to recommend a scheme of distribution which would be suitable for a rapidly growing western muncipality.

In pursuance of these instructions our Mr. Ross obtained in Calgary a great deal of detail information regarding the power situation, the probable demands for power and the approximate location of power centres, and made an inspection of the present civic power plant.

Up till the present we have been dealing with all the matters referred to above with the intention of embodying the results in one large report, but as the power situation has become very acute, and it becomes advisable for you to quickly decide upon the best method of handling this situation, we deal in this partial report only with the question of the costs of power developed by various methods, so that you may make your decision as to increases quickly, leaving to a later report all further matters relating to the power demand at present and in future, its centre of location, the best methods of transmission and distribution, and the lay-out of an underground system, etc.

With regard to the amount of power demand, although this will be dealt with in another report, in order to place you in possession of the scale of your requirements, we estimate that in ten years, when the city of Calgary will have attained a population of 200,000, you will have an output of from 40 to 45,000 kilowatts.

Under Eastern conditions this would appear an excessive allowance, but we might call attention to the fact that (1) you anticipate bonusing industries by means of cheap power, which will inevitably mean a large demand for power for industrial purposes; (2) that, owing to the cheap rates, electric light will be universally used, and (3) that your output will be more readily absorbed by new industries, which are not committed to any particular method of power development as in older established municipalities, where the industries are already supplied with their own power plants, all of which will tend to make your demands much higher than for a similar-sized municipality in the East.

In any case, however, the magnitude of your requirements is such that in future your plant should be increased in fairly large units, which we have placed at 5,000 kilowatts each, and if our expectations as regards your total requirements be met, an equipment of this size would have to be added about every year and one-half on the average.

Your present plant, while suited to past needs, is entirely out of scale for future requirements, owing to the small size of both boiler and engine units, but, inasmuch as it is in existence and will have to be used, whatever source of power be adopted for the future, we have left it out of consideration in the comparative costs of power to follow, knowing that it will add to each the same amount, and, therefore, not effect the relative costs.

This report, therefore, may be understood to deal only with the question of the comparative costs of power from different available sources, on the basis of a plant capacity of 45,000 kilwatts eventually equipped with 5,000 kilowatt units.

We have endeavored to place these sources of power on as directly comparable a basis as possible, and have assumed in every case an average load factor of 50 per cent., which we feel will probably be attained, owing to your heavy industrial loads and your widely extended street railway system.

In all the estimates and figures to follow we have considered the cost of power developed at the generator terminals, but have not allowed for switching, transmission, or any other item, as at this point the costs of the different classes of power are more directly comparable than at any other; further, we have assumed in every case that the plant will be located in its present position at Victoria Park, and increases will be met by extensions to the present buildings. This position with its ready access to water and coal appears to be decidedly the most favorable we have seen and is situated fairly in the centre of the load which may be anticipated.

If, however, another site should be determined upon than the above, this will not appreciably affect the relative figures of cost of power given herein.

Sources of Power

An investigation of the conditions existing in Calgary reveals several sources of power, which we consider in detail in the order given below:—

(a) Hydro-electric power by contract with the Calgary Power Company;

(b) Power obtained from coal fired boilers and steam turbine generator sets;

(c) Power obtained from natural gas-fired boilers and steam turbine generator sets;

(d) Natural gas engines operating generators;

(e) Combination of coal fired boilers and steam turbines with power from the Calgary Power Company;

(f) Combination of gas-fired boilers and steam turbines with hydro-electric power from the Calgary Power Company.

(g) Natural gas engine power supplemented by power from the Calgary Power Company.

(a) Calgary Power Contract.

There is under negotiation at the present time a contract with the Calgary Power Company at the following rates:—

For the first	5,000 horse power,	$26 per year
For the next	1,000 horse power,	25 per year
For the next	1,000 horse power,	24 per year
For the next	1,000 horse power	23 per year
For the next	1,000 horse power	22 per year
For the next	1,000 horse power	21 per year
For all over	10,000 horse power	20 per year

Under this contract power is sold to the municipality at the sub-station of the Power Company in Calgary, and provided the city is properly safeguarded against interruptions, and also provided that the load is such that this power can be utilized continuously for twenty-four hours per day, the

contract is a good one for the city to enter into; if, however, the power is unreliable and no effective guarantees can be obtained, the contract is not a good one for the city; further, if the city does not use this power for twenty-four hours a day the contract becomes of lessened value—by way of illustration—if the cost at $26.00 per horse power, which is equivalent to $34.50 per kilowatt year, can be used twenty-four hours a day and three hundred and sixty-five days in the year, making in all 8,760 hours, the cost per kilowatt hour will be 0.4c. If, however, the average use is only 50 per cent. of the hours above, then the cost per kilowatt hour is 0.8c—the latter being above what power can be produced for from several other sources, as will be seen later.

As a matter of fact, the loads which you will have within a year will absorb this power for the full twenty-four hours, so that our recommendation in this regard is to accept the contract, provided safeguards are introduced against interruptions, and that if the service is as unreliable in the future as it has been in the past, then that the contract may be cancelled.

(b) Steam Generated from Coal.

Under this head we have estimated upon 5,000 kw. units as follows:—

Boiler plant in 500 horse power units, with superheater, economiser, stokers, feed water heaters, feed pumps and draft fans, with stack, equipped with coal bunkers and coal and ash-conveyors;

Engine plant to consist of one 5,000 kilowatt steam turbine, with surface condenser, air and circulating pumps, operating at a pressure of 150 lbs. at throttle, 100 degrees of superheat and twenty-six inches of vacuum together with the necessary motor-driven exciters.

The above general specifications, which is intended to cover a modern economical equipment, may be varied in a number of ways when further study is given to the matter. As it stands, however, it is complete enough for use for comparative purposes with power produced in other ways.

We have estimated for each increase of plant in the capital and operating costs and fixed charges, the details of which are given in Table I. In making up these estimates we have used the prices paid for labor in your present plant, and for fuel have used the average price of coal under present conditions. From the table you will see that—

(1) The capital costs are estimated at $46.00 per kilowatt;

(2) The costs per kilowatt year, on a 50 per cent. load factor basis vary from $37.20 to $32.36;

(3) The costs per kw.h. on a 50 per cent. load factor basis, vary from 0.85c to 0.74c.

(c) Power from Gas-Fired Boilers.

In this case the plant will be identical with that described in case (b) above, with the exception of the omission of stokers and coal bunkers, but with the addition of gas burners and plain grates, by means of which boilers may be hand-fired with coal should occasion arise. We have used the same unit labor prices as in the case of coal-fired boilers, but have changed the boiler-room labor to allow for the use of gas in place of coal.

The gas we have assumed as costing 15c per thousand cubic feet of 1050 B.t.u. gas, and have made due allowance in the consumption for its superior efficiency per B.t.u. over that of coal, due to the fact that it may be burned with a smaller excess of air; that the boilers do not become fouled with soot; that banking is more economically carried out; and that loss of coal from the grates is eliminated.

Table II. summarizes the results, from which it will be seen that—

(1) The capital costs are $45.00 per kw.;

(2) The operating costs per kilowatt year on a 50 per cent. load-factor basis, vary from $31.38 to $27.34;

(3) The cost per kilowatt hour, at 50 per cent. load factor, varies from 0.71c to 0.62c.

(d) Natural Gas Engine Plant.

(1) The capital cost per kilowatt is $91.00;

(2) The cost per kilowatt year, at 50 per cent. load factor will vary from $26.46 to $24.13;

(3) The cost per kilowatt hour, at 50 per cent. load factor will vary from 0.60c to 0.55c.

The figures are given, in detail, in Table III.

(e) Combined Coal-Fired Boilers and Calgary Power Co.

Under this head we have assumed that one of the 5,000 kilowatt units, as indicated in case (b), is omitted, and power to that extent purchased from the Calgary Power Company, under the contract prices which are given in case (a).

If that contract be accepted you will have to pay immediately for 5,000 horse power and have the right to take additional power as required. We have therefore assumed that you finally take from them 5,000 kilowatts, or 6,667 horse power, and that this power is used for twenty-four hours on the base of the load curve and that the remainder of your requirements are met by the use of steam turbine generating sets and coal-fired boilers, as in case (b).

Under this condition, with the average load factor at 50

Table I.—Capital and Operating Costs:—Steam Plant Coal Fired

No. of Units	1	2	3	4	5	6	7	8	9
Capacity	5,000 kw.	10,000	15,000	20,000	25,000	30,000	35,000	40.000	45,000
Capital cost	$	$	$	$	$	$	$	$	$
Buildings, etc.	34,610	69,220	103,830	138,440	173,050	207,660	242,270	276,880	311,490
Boilers, etc.	78,000	156,000	234,000	312,000	390,000	468,000	546,000	624,000	702,000
Engines, etc.	93,250	186,500	279,750	373,000	466,250	559,500	652,750	746,000	839,250
Engineering contingencies.	25,733	51,465	77,198	102,930	128,663	154,395	180,128	205,860	231,593
Total	231,593	463,185	694,778	926,370	1,157,963	1,389,555	1,621,148	1,852,740	2,084,333
Operating costs									
Coal	120,560	241,120	361,680	482,240	602,800	723,360	843,920	964,480	1,085,040
Labour	30,036	30,036	31,934	40,351	44,950	46,270	49,920	49,920	52,767
Supplies, etc.	3,000	6,000	9,000	12,000	15,000	18,000	21,000	24,000	27,000
Maintenance	4,632	9,264	13,896	18,528	23,160	27,792	32,424	37,056	41,688
Depreciation	11,580	23,160	34,740	46,320	57,900	69,480	81,060	92,640	104,220
Total operating	169,808	309,580	451,250	599,439	743,810	884,902	1,028,324	1,168,096	1,310,715
Interest	11,580	23,160	34,740	46,320	57,900	69,480	81,060	92,640	104,220
Sinking fund	4,632	9,264	13,896	18,528	23,160	27,792	32,424	37,056	41,688
Total	186,020	342,004	499,886	664,287	824,870	982,174	1,141,808	1,297,792	1,456,623
50 per cent. load factor									
Cost per kw.h.	0.85	0.78	0.76	0.76	0.75	0.75	0.74	0.74	0.74

Table II.—Capital and Operating Costs:—Steam Plant, Gas-Fired

No. of Units	1	2	3	4	5	6	7	8	9
Capacity	5,000 kw.	10,000	15,000	20,000	25,000	30,000	35,000	40,000	45,000
Capital cost	$	$	$	$	$	$	$	$	$
Building, etc. ...	34,610	69,220	103,830	138,440	173,050	207,660	242,270	276,880	311,490
Boilers, etc. ...	70,500	141,000	211,500	282,000	352,500	423,000	493,500	564,000	634,500
Engines, etc.	95,750	191,500	287,250	383,000	478,750	574,500	670,250	766,000	861,750
Engineering									
contingencies	25,108	50,215	75,323	100,430	125,538	150,645	175,753	200,860	225,968
Total	225,968	451,935	677,903	903,870	1,129,838	1,353,805	1,581,773	1,807,740	2,033,708
Operating costs									
Gas	98,550	197,100	295,650	394,200	492,750	591,300	689,850	788,400	886,950
Labour	23,748	23,748	23,748	29,381	30,330	31,650	31,650	31,650	31,650
Supplies, etc.	3,000	6,000	9,000	12,000	15,000	18,000	21,000	24,000	27,000
Maintenance	4,520	9,040	13,560	18,080	22,600	27,120	31,640	36,160	40,680
Depreciation	11,298	22,596	33,894	45,192	56,490	67,788	79,086	90,384	101,682
Total operating ...	141,116	258,484	375,852	498,853	617,170	735,858	853,226	970,594	1,087,960
Interest	11,298	22,596	33,894	45,192	56,490	67,788	79,086	90,384	101,682
Sinking fund	4,520	9,040	13,560	18,080	22,600	27,120	31,640	36,160	40,680
Total	156,934	290,120	423,306	562,125	696,260	830,766	963,952	1,097,138	1,230,322
50 per cent. load factor									
Cost per kw.h.	0.71	0.66	0.64	0.64	0.64	0.63	0.63	0.62	0.62

per cent., and with the hydro power purchased being assumed as used on a 100 per cent. load factor, the load factor of the steam plant is one which will vary with every additional increase of plant, beginning with 20 per cent. and running up to 44 per cent., for which due allowances have been made in the costs.

It will be seen that the effect of the purchase power from the Calgary Power Company is to decrease costs very materially at the start, but thereafter the amount purchased becomes such a small portion of your whole requirements that the effect is not great.

The details of capital and operating costs are given for the various demands in Table IV., from which it will be seen that—

(1) The costs per kilowatt year vary from $26.34 to $30.45, on a 50 per cent. load factor basis;

(2) The costs per kilowatt hour, at 50 per cent. load factor, vary from 0.53c to 0.70c.

(f) Combined Gas-fired Boilers and Calgary Power Co.

The costs of power have been estimated in this case under the same conditions as for case (e), substituting gas for coal as fuel under the boilers.

As before, the steam turbine sets supply all the power demands of the City over and above the 5,000 kw. purchased from the Calgary Power Company.

The changing load factors on the steam plant occur as before and have been taken into consideration.

Table V. gives the figures of capital and operating costs under these conditions, from which it will be seen that—

(1) The cost per kilowatt year, on a 50 per cent. load factor basis, varies from $24.09 to $26.18;

(2) The cost per kw.h. on a 50 per cent. load factor basis, varies from 0.50c to 0.60c.

(g) Gas Engines and Calgary Power Company

The costs of power has been estimated in this case under the same assumptions as in the previous cases, (e) and (f), except that gas engines are substituted for boilers and steam turbine sets, and supply all the power requirements of the city over and above the 5,000 kilowatts purchased from the Calgary Power Company, as in the other cases.

The changing load factors on the gas engines also occur as in the previous cases, and have been taken into consideration in the estimates—the details of which are shown in Table VI. It will be seen from this table that—

(1) The cost per kilowatt year, at 50 per cent. load factor, varies from $25.08 to $24.72;

Table III.—Capital and Operating Costs:—Gas Engine Plant

No. of units	2	4	6	8	10	12	14	16	18
Capacity	5,000 kw.	10,000	15,000	20,000	25,000	30,000	35,000	40,000	45,000
Capital cost	$	$	$	$	$	$	$	$	$
Building, etc	78,900	157,800	236,700	315,600	394,500	473,400	552,300	631,200	710,100
Engines, etc.	327,500	655,000	982,500	1,310,000	1,637,500	1,965,000	2,292,500	2,620,000	2,947,500
Engineering									
contingencies	50,800	101,600	152,400	203,200	254,000	304,800	355,600	406,400	457,200
Total	457,200	914,400	1,371,600	1,828,800	2,286,000	2,743,200	3,200,400	3,657,600	4,114,800
Operating costs									
Gas	45,990	91,980	137,970	183,960	229,950	275,940	321,930	367,920	413,910
Labour	15,329	15,329	17,549	21,886	24,306	26,326	28,546	30,766	32,986
Supplies, etc.	7,000	14,000	21,000	28,000	35,000	42,000	49,000	56,000	63,000
Maintenance	9,144	18,288	27,432	36,576	45,720	54,864	64,008	73,152	82,296
Depreciation	22,860	45,720	68,580	91,440	114,300	137,160	160,020	182,880	205,740
Total operating ...	100,323	185,317	272,531	361,862	449,276	536,290	623,504	710,718	797,932
Interest	22,860	45,720	68,580	91,440	114,300	137,160	160,020	182,880	205,740
Sinking fund	9,144	18,288	27,432	36,576	45,720	54,864	64,008	73,152	82,296
Total	132,327	249,325	368,543	489,878	609,296	720,314	847,532	966,750	1,085,968
50 per cent. load factor									
Cost per kw.h.	0.60c	0.57c	0.56c	0.56c	0.56c	0.55c	0.55c	0.55c	0.55c

Table IV.—Capital and Operating Costs—Combined Calgary Power Company Service and Steam—Coal Fired

No. of steam units	0	1	2	3	4	5	6	7	8
Power generated	0 kw.	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000
Power purchased	5,000 kw.	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Load factor of	%	%	%	%	%	%	%	%	%
System		60	50	50	50	50	50	50	50
Steam plant		20	25	33	37½	40	41½	43	44
Capital cost of		$	$	$	$	$	$	$	$
Steam plant		231,593	463,185	694,778	926,370	1,157,963	1,389,555	1,621,148	1,852,740
Operating cost									
Coal		53,597	130,205	253,979	377,753	501,661	625,301	748,674	872,850
Labour		20,565	23,193	27,457	33,025	36,243	37,182	40,028	43,028
Supplies		3,000	6,000	9,000	12,000	15,000	18,000	21,000	24,000
Maintenance		4,632	9,264	13,896	18,528	23,160	27,792	32,424	37,056
Depreciation		11,580	23,160	34,740	46,320	57,900	69,480	81,060	92,640
Total operating		93,374	191,822	339,072	487,626	633,964	777,755	926,186	1,069,574
Interest		11,580	23,160	34,740	46,320	57,900	69,480	81,060	92,640
Sinking fund		4,632	9,264	13,896	18,528	23,160	27,792	32,424	37,056
Total		109,586	224,246	387,708	552,474	715,024	875,027	1,039,670	1,199,270
Cost of purchased power	171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000
Total		280,586	395,246	558,708	723,474	886,024	1,046,027	1,210,670	1,370,270
Cost per kw.h.		0.53c	0.60c	0.64c	0.66c	0.67c	0.68c	0.69c	0.70c

(2) The cost per kilowatt hour, at 50 per cent. load factor, varies from 0.52c to 0.57c.

Producer Gas Power

It will be noted that no estimates have been made nor curves shown for the cost of power from producer gas made at the works and utilized in producer gas engines, the reason being, as very small amount of figuring will indicate, that the cost of producer gas at the prices which you have to pay for coal is greater than that of natural gas at 15 cents. To illustrate this matter we would call attention to the following figures—

Natural gas, of 1050 B.t.u. as furnished the municipality at 15 cents per thousand gives the following result:—

1000 B.t.u. x 1000 cubic feet = 1,000,000 B.t.u. for 15 cents = 66,666 B.t.u. for 1 cent.

If producer gas be used a battery of producers will have to be provided in addition to the gas engines, which are allowed for in the case of natural gas, and the fixed charges on these will have to be paid together with the interest, sinking fund, etc.—all additional to the cost by the use of natural gas engines.

It results, therefore, that a considerable saving will have to be made in the cost of producer gas per thousand cubic feet in order to make up for this increase. If we assume a producer efficiency of 80 per cent., which is high, the following table indicates the prices which would have to be paid per ton for coal at the plant in order to produce 66,666 B.t.u. for one cent, as is the case of natural gas. Column No. 1, Table VII., indicates heating value per pound of coal; column No. 2 indicates the heat value in the gas produced from one pound of coal; column No. 3, price per ton which would equate with natural gas price.

Table VII.

B.t.u. per pound coal	B.t.u. gas	Equivalent cost per ton
14,000	11,200	$3.36
13,000	10,400	3.12
12,000	9,600	2.88
11,000	8,800	2.64

Table V.—Capital and Operating Costs—Combined Calgary Power Company Service and Steam Gas Fired

No. of Steam Units.	0	1	2	3	4	5	6	7	8
Power generated	0 kw.	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000
Power purchased	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Load factor of system		60%	50%	50%	50%	50%	50%	50%	50%
Load factor of steam plant		20%	25%	33%	37½%	40%	41½%	43%	44%
Capital cost of		$	$	$	$	$	$	$	$
steam plant		225,968	451,935	677,903	903,870	1,129,838	1,355,805	1,581,773	1,807,740
Operating cost									
Gas		41,588	102,492	202,323	302,154	402,084	501,989	601,647	701,714
Labour		17,781	18,657	21,972	22,848	26,139	26,139	28,335	28,335
Supplies		3,000	6,000	9,000	12,000	15,000	18,000	21,000	24,000
Depreciation		11,298	22,596	33,894	45,192	56,490	67,788	79,086	90,384
Maintenance		4,520	9,040	13,560	18,080	22,600	27,120	31,640	36,160
Total operating		78,187	158,785	280,749	400,274	522,313	641,036	761,700	889,593
Interest		11,298	22,596	33,894	45,192	56,490	67,788	79,086	90,384
Sinking fund		4,520	9,040	13,560	18,080	22,600	27,120	31,640	36,160
Total.		94,005	190,421	328,203	463,546	601,403	735,944	872,434	1,007,137
Cost of purchased power	171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000
Total		265,005	361,421	499,203	634,546	772,403	906,944	1,043,434	1,178,137
Cost per kw.h.		0.50c	0.55c	0.57c	0.58c	0.59c	0.59c	0.60c	0.60c

Table VI.—Capital and Operating Costs—Combined Calgary Power Company Service and Gas Engine Plant

No. of gas units	0	2	4	6	8	10	12	14	16
Power generated	0 kw.	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000
Power purchased	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Load factor of system		60%	50%	50%	50%	50%	50%	50%	50%
Load factor of gas plant		20%	25%	33%	37½%	40%	41½%	43%	44%
Capital cost of gas plant		$ 457,200	$ 914,400	$ 1,371,600	$ 1,828,800	$ 2,286,000	$ 2,743,200	$ 3,200,400	$ 3,657,600
Operating cost									
Gas		19,710	49,275	98,550	147,825	197,100	246,375	295,650	344,925
Labour		12,233	12,233	17,549	17,549	24,106	24,106	28,546	28,546
Supplies		7,000	14,000	21,000	28,000	35,000	42,000	49,000	56,000
Maintenance		9,144	18,288	27,432	36,576	45,720	54,864	64,008	73,152
Depreciation		22,860	45,720	68,580	91,440	114,300	137,160	160,020	182,880
Total operating		70,947	141,316	231,111	321,390	416,226	504,505	597,224	685,503
Interest		22,860	45,720	68,580	91,440	114,300	137,160	160,020	182,880
Sinking fund		9,144	18,288	27,432	36,576	45,720	54,864	64,008	73,152
Total		102,951	205,324	329,123	449,406	576,246	696,529	821,252	941,535
Cost of purchased power	171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000
Total		273,951	376,324	500,123	620,406	747,246	867,529	992,252	1,112,535
Cost per kw.h.		0.52c	0.57c	0.57c	0.57c	0.57c	0.57c	0.57c	0.565c

10,000	8,000	2.40
9,000	7,200	2.16

It will be seen from the above that you cannot purchase coal at your plant of the heat values given at any such price as will enable producer gas to compete with natural gas on the basis of fuel alone, and when it is considered that in addition a capital investment will have to be made in the producer plant, which is not necessary in the case of natural gas and the fixed charges paid on this capitalization, together with additional attendance necessary for firing, scrubbing and cleaning gas, etc., added, it is quite evident that if gas engines are to be used at all natural gas is the proper fuel.

Inasmuch as this producer question has been raised very sharply, we expect to supplement this report with another one, dealing with the producer gas situation, but the above should be sufficient, without any further details, to indicate its standing in the discussion.

Hydraulic Power From Bow River

A scheme has been brought forward by the Alberta Development Company to utilize the fall of the Bow River, below St. George's Island. Certain maps and information have been given us in dealing with this matter—the idea being that the city should either purchase the rights and construct the four plants necessary or, possibly, purchase power from the company, they making their own installation.

If power can be purchased from this company at the same rates and under the same conditions as the proposed contract between the Calgary Power Company and the municipality, it should be acceptable to the city, and as the reports of the company indicate that at $25.00 per h.p. year they can make a reasonable profit, there ought to be no difficulty in having the scheme financed on the basis of a contract with the city, and the city would be safe enough in offering them the same terms that they have to the Calgary Power Company.

As regards the matter of the city taking over the rights and constructing the power plants; the information is not in sufficient detail to enable us to recommend the city in this regard, but we are making a fuller study of the matter, and will report more in detail later. In the meantime, however, we know enough to be certain that this power, even if developed, can not affect the recommendation contained herein, as it could not possibly be ready for use for a couple of years at least, and, in the meantime, an additional plant must be purchased to meet imminent needs.

Summing Up

The details of power costs under different methods of production being given, each under its own head, final results are summarized on the sheet annexed, entitled, "Curve of Cost of Power at Generator Terminals," and the vital facts are much more readily grasped by an inspection of this sheet than by the individual tables; and it should be noted that,—

(1) The scale is a very large one, so that differences in cost appear to be exaggerated upon first inspection;

(2) In every case a load factor of 50 per cent. has been used. A different load factor would change results—a lower load factor favoring steam and a higher gas;

(3) Power purchased at $26.00 per h.p. and used 24 hours per day reduces the cost of all systems up to 15,000 kw. but is beaten thereafter by the gas engine alone—the difference, however, being only about .02 of a cent per kilowatt hour;

(4) In the curve the costs in dollars per kw. year and per h.p. year are also given at the same load factor.

Recommendations

Our recommendations are:—

(1) To conclude a contract with the Calgary Power Company on the basis set forth above, provided reliable service is guaranteed;

(2) To purchase for immediate use steam turbines and boilers, as this is considered the only quick solution of the power situation, which is critical at the present time and may be intolerable next winter unless something is done quickly;

(3) For future extensions thereafter, if there is no change in the art in the next few years, steam turbines with gas-fired boilers will be our recommendation, in spite of the greater economy of the gas engine.

(4) Should the development of the gas engine or gas turbine or some other improvement, render it possible to utilize other sources of power than that recommended, there will be no difficulty in introducing it later when it is ripe.

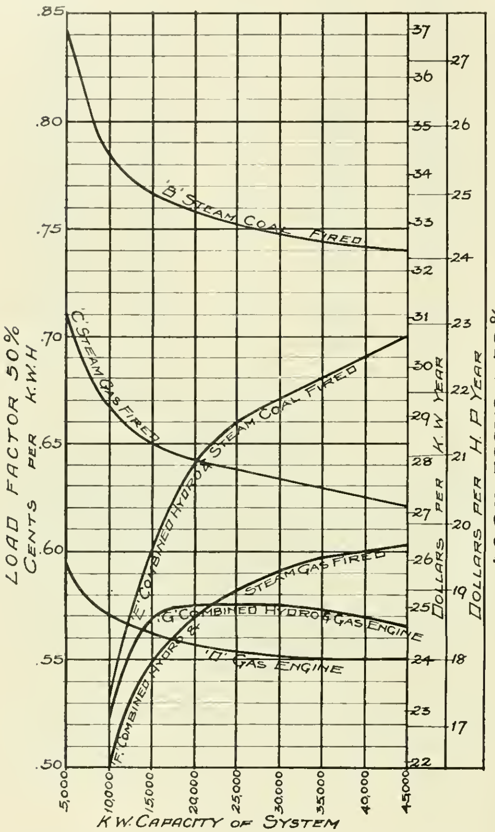
Our recommendations are as above in spite of the fact that the gas engine, from a power standpoint, is the cheapest.

In combination with hydro power steam from gas-fired boilers is cheaper than hydro and gas engine up to 20,000 kilowatts. The natural gas engine is hampered as follows:—

(1) The great capital investment being 100 per cent. more than for steam equipment;

(2) The whole service will depend upon the integrity of a pipe line 172 miles long;

(3) The large gas engine is not in such a stage of development as yet as will insure its success in your plant, and



Curves showing cost of power at generator Terminals.

the use of smaller units would increase the capital and operating costs considerably over those indicated in our report.

The advantages of steam as compared with gas in this case are as follows:—

(1) The decreased capital cost involved;

(2) The utilization of natural gas with coal as a standby in case of failure of pipe line;

(3) The establishment of a plant in which every item has been tried out for years and in which no experimenting is necessary;

(4) The greater probability of quick deliveries of apparatus.

In conclusion we desire to call your attention to the necessity for immediate action in connection with this matter. By next fall you will have a load of 12,000 kw. and your equipment at the present time is sufficient for only about 6,000 kw. If a contract be concluded with the Calgary Power Company you will have an additional amount of power of 3,700 kw. There will, however, have to be purchased in any case 2,500 kw. of equipment of some kind, and, if the power contract be not concluded, there will have to be purchased a total amount of 6,000 kw. as the loads will approximate 12,000 kw. by about the first of November next, and you have virtually six months in which to order, have built, and installed this entire equipment—a time altogether too short already.

There is only one solution of this matter, and that is for immediate requirements, steam turbines with gas-fired boilers, as gas equipment can by no possibility be got within that time.

If you wish to investigate further the producer gas engine proposition for future extensions, this can easily be done, but to delay the installation of the present necessary plant further on this account is fatal.

Personal

Mr. Geo. C. Burnham has severed his connection with the firm of Kilmer, Pullen & Burnham, Limited, Toronto.

Mr. T. H. Nicholson, of the Bell Telephone Company, will be nominated for president of the Montreal Society by the nominating committee. There are now 360 members.

Mr. C. H. Mitchell, C.E., of the firm of C. H. and P. H. Mitchell, consulting engineers, Toronto, has been appointed a member of the Board of Governors of the University of Toronto.

Mr. F. Jno. Bell, general manager of the Canada Wire & Cable Company, sailed for London, Eng., May 17, by S.S Corsican, on business connected with his company. Mr. Bell will be absent six weeks or more.

Mr. R. A. Becker has been appointed supervisor of signals on the Eastern Lines of the G. T. R. Company, having charge of interlocking plants, automatic signals, electric crossing bells, etc., with headquarters at Montreal.

Mr. Jas. Veitch, formerly of Bruce, Peebles Electric Company, Edinburgh, and latterly on the staff of the Donaldson Liner S.S. Cassandro, has joined the engineering staff of Mr. Chas. F. Gray, consulting electrical engineer, 1005 Union Trust Building, Winnipeg.

Mr. W. D. Murrin until lately connected with the London (Eng.) United Railway has succeeded Mr. S. P. Thompson as mechanical superintendent of the British Columbia Electric Railway Company. Mr. Thompson, who came from New York, has returned to that city to enter into partnership with Mr. Roosevelt, who was formerly transportation manager of the B. C. Electric system.

Mr. George H. Harper, chief engineer and manager of the Brandon Gas & Power Company, which is one of the holdings of the Continental Gas and Electric Corporation, has been promoted to the position of chief gas engineer of the company at Cleveland. Mr. Roy Milhren, formerly of the Public Service Company, of North Illinois, and graduate of Wisconsin University, has taken the place vacated by Mr. Harper in Brandon.

Mr. W. F. Graves, late superintendent of track of the Chicago City Railway Company, has been appointed chief engineer of the Montreal Tramways Company. Mr. Graves, who has had a wide experience in civil engineering work, began his career with the Chicago, Rock Island & Pacific Railway in 1895, and after five years service in different departments was appointed engineer of maintenance of way of the Southwestern district of the company. Subsequently, he was engaged by the Missouri Pacific Railway as assistant engineer of maintenance of way, a position he held for three years. The next four years was spent with the South Side Elevated Railroad of Chicago as engineer of construction, and he was then appointed superintendent of track of the Chicago City Railway Company, where he remained for six years. Mr. Graves is a member of the American Society of Civil Engineers, the Traffic Club of Chicago, and the Chicago Engineers' Club.

High Frequency vs High Voltage Tests

In a recent issue we review a paper presented by Mr. Imlay & Thomas before the American Institute of Electrical Engineers on the subject of High Frequency Tests of Line Insulators. This paper reported the results of a number of interesting experiments which all went to prove that the behavior of insulators under high frequencies is not the same as their behavior under commercial frequencies and that the failure of a line is very often the result of a high frequency condition rather than of a high voltage condition.

At the same meeting Mr. P. W. Sothman, formerly chief engineer of the Hydro-electric Power Commission of Ontario, presented a paper describing comparative tests of high tension suspension insulators, this paper covering much of the work that had been done by Mr. Sothman in Ontario as well as the results of his wide experience gained before and since that period.

The discussion on these papers has been unusually interesting and general, showing that both these subjects are considered, by leading engineers, as of vital importance. We are able to print below extracts from the expressed opinions of a number of well known engineers on the matter contained in these two papers.

Mr. Ralph D. Mershon: There are a number of things in connection with the paper by Messrs. Imlay and Thomas that are not clear to me, and which I would like to have Mr. Thomas elucidate. For instance, in their paper there is shown a metal band around the insulator, and it is said that the effect of that metal band is equivalent to increasing the diameter of the pin. That is not quite clear, neither is it quite clear that putting a cap on the insulator is equivalent to reducing the diameter of the pin, the opposite effect of the band.

As to the change in voltage distribution over an insulator with change of frequency, I think there is no doubt about that, both from theoretical considerations and from measurements in connection with some high-voltage tests made at Niagara on which I reported to the Institute some time ago. These measurements were of the losses on insulators. The losses varied with the frequency. Inasmuch as other measurements made at that time indicated there was little, if any, loss in the porcelain of the insulator, it appeared that the losses measured were mainly confined to the surface of the insulator. And the only acceptable explanation for the variation of these losses with frequency was that as the charging current of the insulator changed with the different frequencies, the amount of charging current that had to flow over the surface changed, resulting in the change in the values of the losses. That change in loss would indicate a change in distribution similar to the one of which Mr. Thomas speaks, because change of loss, due to a change of charging current, means a change in the voltage absorbed on those parts of the surface over which the current has to flow in order to charge other portions of surface.

There can be little question in the mind of any one who has to do with transmission lines that the main point brought out in this paper is correct; namely, that the behavior of insulators under high frequency is not the same as their behavior under commercial frequencies. Again and again there are punctured in service insulators, which under test at commercial frequencies would flash over rather than puncture. This happens with wooden as well as metal pins, although it happens more frequently with metal pins. But you do not have to go to insulators to see there is a difference between action of high and low frequencies. You have seen a dry transmission line pole struck by lightning and shattered. Instead of taking the perfectly easy path through the air alongside the pole, the lightning preferred to go through the pole and smash it to pieces. I could understand how the lightning might choose a green tree with the sap in it, rather than the air alongside of it, but it is difficult to understand why it should prefer to go through a dry pole, which we have reason to believe would, if tested at commercial frequencies, flash over before it would pass any serious amount of current.

High-frequency tests should be continued further, and the endeavor should be made, when more knowledge as to these phenomena has been obtained, to connect up the effect of high-frequency tests with the results of tests at commercial frequencies. In other words, the endeavor should be made to determine what tests at commercial frequencies (either as to voltage or time, or both) would constitute an equivalent of high-frequency tests, so that tests can be made under ordinarily available conditions, equivalent to tests at high frequency.

In Mr. Sothman's paper rather undue emphasis seems to be laid upon factors of safety relative to the line voltage. It would seem that our experience, extending over a number of years, has shown that the problem of insulating a transmission line is not so much a problem of insulating the line voltage—that is comparatively easy—but the problem of insulating or protecting it against lightning or lightning effects.

On the last page of his paper Mr. Sothman has spoken in a rather discouraged way in regard to higher voltages. Now, while I agree with him that in some cases it would seem that higher voltages have been adopted than were justifiable, I think them unjustifiable on the score of economics rather than on the score of difficulties to be met with in operation. There is no particular reason to believe that the percentage of electrical troubles will be any greater with higher voltages, requiring an increased number of units in the suspension insulator, than there are now, though I can see some chance for a considerable increase in mechanical troubles.

Mr. Mershon then discusses at some length and somewhat mathematically the question of the distribution of the impressed voltage over a string of insulators and concludes.

It would seem, therefore, that in considering the voltage distribution over a string of insulating units the end unit condition previously discussed with reference to direct current must be taken into consideration, especially if the insulating units are placed close together. It is even more important when one comes to consider an insulator with more than one petticoat, because in this case the two or more petticoats give a result very similar to that of insulating units very closely spaced.

I believe, however, that the matter of string ratio and voltage distribution over the string is of a great deal less importance than that of the relation between the dry flash-over value and the puncture value of the unit. As previously stated, the problem of insulating the line against the voltage of the line is a comparatively easy one. The difficult part is to insulate the line against lightning. It is easy enough to put enough insulating units together to hold the voltage of the line. It is not so easy to get insulating units of such characteristics as will insure that there always be a flash-over rather than a puncture. And while it is desirable to have as good voltage distribution as possible, I consider voltage distribution entirely secondary in importance to a high puncture value of the units relative to the dry flash

over value of the unit. In this connection it is well to remember that a good voltage distribution with commercial frequencies does not necessarily mean a good one with frequencies equivalent to lightning, and that therefore the endeavor for a good voltage distribution at commercial frequencies is, beyond a certain point, a waste of time which might be much better devoted to the endeavor to increase the ratio of puncture value to flash-over value of the individual units.

Mr. P. M. Lincoln: Some of the deductions made by Messrs. Imlay and Thomas from the facts presented in their paper are deductions with which I cannot agree. In the first place, they use throughout this whole discussion the term "high-frequency tests." Now, they may be high-frequency tests or they may not be. There is not one iota of proof that the tests which they have described really do produce high frequency upon the insulator. The fact, if it is a fact, that high frequency exists on that insulator, is one that must be deduced entirely by inference. When a condenser discharges through a given circuit, if proper assumptions are made, one may infer that the discharge is alternating and of high frequency. Whether it is high frequency and alternating, or not, depends upon the amount of energy stored in the condenser as related to the rate at which this energy is dissipated once the discharge starts. It is my idea that if the discharge is alternating, the rate of decadence is so great that it is questionable whether the actual discharge is governed by the laws which govern alternating currents. When the rate of decadence is high, it requires only a relatively small number of alternations before the value of the voltage has dropped practically to zero.

It is admitted, however, that the method of testing as described in this paper does produce an exceedingly sudden application of voltage to the insulator, and one that exists for a very brief length of time. I believe it is due to the fact that the voltage exists on the insulator for such a very brief period of time, that we find the unexpected results which have been described by the authors.

There is one thing which has been omitted by the authors, and that is, a minute description of just how the voltage is applied. The authors state that the "application" exists for a period of one to two seconds, but there is no way of telling how many shocks the insulator receives during a single "application." It may receive one shock every alternation, in which event there will be some 200 or 300 shocks per application, or it may be that there is a shock only every tenth alternation, or some such matter, or it may be that there is a shock on the insulator a good many times per alternation. It would be interesting if we could have some data to settle this question.

The authors have submitted some "speculations," as Mr. Thomas has called them, by which they attempt to explain the results of the tests. They assume that in an insulator the distribution of voltage across its parts is determined by the fact that there is a resistance in series with a capacity, and that the very high frequency to which the insulator is subjected during the tests gives an entirely different distribution of potential over the insulator from what takes place when a frequency of 60 cycles is used. I have my doubts as to whether an analysis will show much weight to this contention. Suppose we have an insulator to which we apply a voltage. The voltage is brought by metallic conductors up to the material of the insulator itself Fig. 1. This voltage appearing on the metallic parts of the insulator causes a current to flow. This current will flow due to two causes, first, because there is a capacity present, and consequently there will be a capacity current flowing through the insulator, and second, because the insulator is not a perfect insulator, but is to a slight extent a resistance, and consequently the voltage which appears will cause current to flow through that resistance. It is apparent that these two paths are not in series, but in parallel, so that any deductions which the authors make on the basis that the paths are in series will not apply. It is perfectly true that the current which flows through the capacity has a 90-degree lead over that which flows through the resistance, but I do not see that that has any particular bearing upon the case.

The tables given in the fourth, fifth and sixth pages of the paper by Messrs. Imlay and Thomas indicate that these so-called high-frequency tests were made with a transformer voltage which ranged between 300,000 and 350,000. Furthermore, the test on insulator "No. 1," indicated that the solid part of that insulator would break down at a voltage somewhere around 200,000. They could not obtain a breakdown on No. 2 insulator, since it flashed-over under oil, before breaking down, but it is fair to suppose that the solid dielectric of insulator No. 2 would break down at somewhere around 300,000 to 350,000 volts, because it is a well-known fact that the dielectric strength of a solid dielectric does not go up in proportion to its thickness and a dielectric two inches thick will not stand twice the voltage of a dielectric one inch thick. If the No. 1 insulator would stand 200,000 volts, it is fair to suppose that the No. 2 would break down at 300,000 or 350,000.

That is about the voltage actually in the transformer during the so-called "high-frequency" tests, and it is my opinion that the only thing which is observed in this breaking down on the "high-frequency" test is simply the result of a voltage of somewhere around 300,000 to 350,000 volts applied to the insulator, and that 300,000 to 350,000 volts is what breaks down the solid dielectric of that insulator. You

Fig. 1.

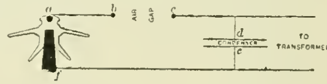


Fig. 2.

may ask why it does not break down the air path, as when a 60-cycle current is applied. My answer, as suggested early in my discussion, is that the time of application is so short that the air does not have time to break down. Dielectrics break down in two separate and distinct manners. The first way may be likened to the breaking down of an oak plank by the penetration of a rifle bullet. That is the manner in which all solid dielectrics break down, and in which the air breaks down under certain conditions. It is my belief, from certain tests which I have seen made, that the breakdown strength of air from the "rifle bullet" method is not so far different from that of solid dielectrics as many suppose. Air, however, may break down in another way, that is, by ionization, but that method requires time. It does not act instantaneously. Ionization occurs by collision and is necessarily a progressive action, and it requires a certain appreciable amount of time for these collisions to extend from one terminal to another. Therefore, if the voltage is applied to the insulator with extreme suddenness, it may break down by the "rifle bullet" method before the parallel air path breaks down by ionization.

I think the statement by the authors that during the "high-frequency" tests not more than 100,000 volts was applied to these insulators, as indicated by the air gap, fails for the same reason. It requires time for the measuring air-gap to break down, and even if the air-gap separation indicates only 100,000 volts, I do not believe it follows necessarily that there was a pressure of only 100,000 volts present. It may have been a much higher voltage.

Another point which should be explained is the manner of determining the frequency of the attack upon these insulators. As I understand it, there is a condenser (d e, Fig.

2) connected in series with an air gap, c b, and the opposite terminal of the air gap is attached to the insulator, the pin f of which is attached to the other side of the condenser. It is my understanding that the million cycles per second which the authors have given as the approximate frequency of the voltage application to the insulator is that which will take place when the path is completed through the insulator, that is, the frequency is that determined by the condenser d e discharging through the inductance of the circuit d c b a f e. It should be noted that the current cannot flow through this path until the breakdown actually occurs. Until that breakdown occurs the frequency is determined simply by static capacity of the insulator discharging into the condenser d e through the path a b c d. In this case the frequency will be governed by this static capacity of the insulator and the inductance of the circuit a b c d. Since the static capacity of the insulator is exceedingly small compared to that of the condenser d e, the theoretical frequency is largely increased. Consequently, instead of a million cycles per second, we may have a theoretical frequency of many times that, possibly a factor of one hundred to one thousand. It is evident, therefore, that the duration of time of strain upon that insulator is exceedingly short, and, according to my conception, this does not give time for the air to ionize between terminals.

I agree with the conclusion of the authors that their tests have opened an exceedingly interesting line of investigation, and one which certainly ought to be followed up.

Mr. F. W. Peek, Jr., dwelt at length on the delay in a discharge through air when high potential stresses are suddenly applied, and discussed the paper of Messrs. Imlay and Thomas from this point of view.

At the moment before high-frequency discharge, or arc-over, the insulator is practically at zero potential. When arc-over occurs the insulator is thus raised very suddenly from zero potential to 325,000 volts, or possibly double this, above zero. This is well above the puncture voltage, as shown by the test under oil, and if this voltage had been gradually applied the stress at high points would have been gradually evened up by conducting air until arc-over occurred and the voltage across the insulator was reduced to zero. With the voltage suddenly applied the air does not become conducting to a great enough extent over the surface in time to relieve the insulators—hence, the porcelain is punctured. Complete puncture may not occur at the first application, but at first only cracks or chips in the porcelain, which gradually develop into puncture. If the petticoat is reduced as in the tests, the time lag for flash-over is reduced and less punctures should occur. There is still another effect which I have noted and which may have a bearing. If potential at low frequency is applied between electrodes and gradually increased, arc-over occurs and the potential across the gap drops to zero, as indicated by a volt meter placed across the gap. In other words, the low-frequency arc "resistance" is practically zero. If, however, at a frequency of say 50,000 cycles from a generator the potential does not drop to zero, but may remain near the applied voltage, that is, the high-frequency arc seems in effect to have a very high resistance, or the high-frequency arc may play over an insulator surface without considerably reducing its potential below the applied value which may still remain above the voltage at which puncture would occur at any frequency, as under oil where arc-over is prevented.

The effect of the time lag of corona means that a good insulator under transient voltages must have a good balance. The suspension insulator should have high string efficiency, as brought out in my paper, previously referred to. This applied also to the parts that makes up the pin type insulator. There must also be ample margin between the low-frequency flash over voltage in air and the puncture voltage under oil.

An interesting point is here brought up in design, or spacing of disks. If potential is gradually applied across a string of say five insulators (as usually spaced) and gradually increased, flash-over takes place first on the unit nearest the line, then over the second, third, and so forth. As there is a time lag for flash over at each insulator this means that a gradually increasing potential is suddenly applied on the units, just as in the Thomas Imlay tests. When the last insulator is reached the full applied voltage is for a short time before arc-over across the insulator. This is far above puncture voltage. I have observed insulators punctured in this way during arc over tests. Thus with low-frequency surge the insulator nearest the tower may puncture. This shows the importance of good string balance, or of having the design such that all insulators will arc over at the same instant. Perfect balance is in the present design hardly possible, so, after designing for the best possible balance, the insulators should be so spaced that arc-over voltage from line to tower is just below the arc-over voltage around one unit.

Mr. Sothman in his paper has brought up many interesting questions. Regarding the question of test precautions, method of voltage control, power required, etc., I would refer to what I have said in the paper previously cited. I should like to add that while the needle gap has long been useful, we have about outgrown it, and it is not reliable above 100 kv. Unless proper corrections are made for humidity the variation is very great, and the voltages indicated are generally too high. This effect is not noticeable where the electrode is such that spark-over takes place before corona forms. Such an electrode should be standardized.

Mr. J. A. Sandford, Jr., speaking of Mr. Sothman's paper and the questions raised therein, said he believed the author had come quite close to the reason why insulators fail on the line even after the most thorough test possible at the factory when he says: "For it is quite probable that precautions now taken in one direction are often unwarranted and uncalled for, whereas, on the other hand, liberal allowances made in other directions may be of the greatest detriment to line and insulators." This seems to be forcibly brought out by the findings of Messrs. Imlay and Thomas as given in their paper. Mr. Sanford discussed these points under the headings, design tests, method of supporting insulator under tests, and wet tests, and says in conclusion:

The company with which the writer is connected has drawn up standard specifications for routine tests, which are used in all cases where specifications are not supplied by the purchaser. Voltages used of course depend on the insulator in question. The periods of time of test, so far as suspension units are concerned, we have fixed, as the variation in size of different insulators is not great; therefore the expense of testing is nearly the same for all styles we make. With reference to pin type, however, the sizes vary greatly, requiring voltages varying from 45,000 to 180,000 volts. The smaller insulators, particularly below 22,000 volts, do not need to be tested so long as the larger sizes, as each porcelain part in the smaller insulator is often as thick as in the larger, and the voltage per part very much less. Furthermore, a long time test on a very small insulator makes the cost of testing out of proportion to the price of the insulator.

The specifications which we have adopted are the result of our experience in testing porcelain insulators, combined with what we find is being asked for in specifications issued by different engineers. They are not as voluminous nor as exacting as some, nor as short and indefinite as others. We feel, however, that they are so drawn as to insure the per-

chaser against receiving defective material, without imposing undue hardships on the manufacturer.

In regard to two-piece insulators, I believe that the specifications may properly contain a statement as to the kind of cement to be used, and if Portland is specified, a statement as to the time of setting. As to the method of cementing, I believe this should be left entirely to the manufacturer, as it is right to suppose that if the manufacturer is following up his methods closely with a view to turning out the best possible product in the most economical manner, and at the same time fulfilling all guarantees made, he is in better position than the purchaser to say how the details of the work shall be carried out. This applies to all other parts of the work as well as the cementing, and will be found to vary in the different factories.

All insulators, whether pin or suspension type, should be tested after having been assembled and the cement is sufficiently set to allow of safe handling. There is a possible exception to this rule in the case of the very small two-part pin type insulators, as it is sometimes found advantageous to test these to flash-over when they come from the kilns, assembling the parts in the test pans without cement, thus testing both parts at once. Water is placed between the parts for this test. In the case of these small insulators it is then safe to cement the parts together and pack the complete insulators without further testing.

The paper by Messrs. Imlay and Thomas at once suggests that it may be desirable to introduce some sort of high-frequency test into the list of tests to be applied in order to make a selection of the proper insulator for a given set of conditions. However, I do not believe there are sufficient data at hand, at present, to allow us to say just what this test should be or how it should be applied. Further, I doubt the advisability of using the same apparatus for this test as is used for the commercial routine tests at the insulator factory.

Since it is coming to be generally acknowledged that the parallel test is the only good way to determine what is the most suitable insulator to meet a set of specified conditions, it seems to me that there should be available some place where such work could be done using the same equipment and conditions of test at all times. At present non-interested companies that are equipped, so far as apparatus is concerned, to make such tests, do not like to go to this trouble to set aside a space and rig up for the various tests, as such work does not pay them, and not having arrangements especially for it, there is more or less danger of injuring the apparatus.

If arrangements could be made with some laboratory or factory having the equipment and not directly interested in the sale or purchase of the insulators, in accordance with which this apparatus in a suitably equipped room could be available at all times, I believe that with proper use of such advantages there would be fewer mistakes made in insulating our transmission lines; and incidentally the owner of the equipment could derive considerable revenue from the making of comparative tests preliminary to the purchase of insulators for a transmission line, and from the use of such equipment for experimental and research work at very high voltages not at present possible except for experimenters connected with our large manufacturing companies.

We will be glad to give anyone copies of the specifications used by the company with which the writer is connected, or in any way to help in a movement for the standardizing of the specifications and the methods of tests on high-tension insulators.

Mr. R. F. Hayward: It is probably safe to say that no long-distance transmission line that has been equipped with insulators designed on any reasonable basis has ever experienced the slightest difficulty from rain or snow. This is absolutely true, at least, in the writer's experience. Consequently all tests of insulators for breakdown under artificial rain conditions, with ordinary frequencies, while being important, should be looked at more in the light of standard tests or strength of iron or steel or cement; in other words, something that has got down to more or less settled conditions.

In the writer's experience with high-tension transmission at 40 and 60 cycles over long distances and wide areas in Utah and Mexico, after eliminating breakdowns due to the mechanical destruction of insulators from outside sources, the only breakdowns of insulators that have passed through the standard tests have occurred in cases where there has undoubtedly been a high-frequency discharge of some kind or other, whether from lightning or as the result of some sudden surge, as from a heavy short-circuit.

Calgary Police System

The City of Calgary has recently awarded the contract for a complete police signal system to the Northern Electric & Manufacturing Company. The office will be of the type known as the Gamewell type "A" or Unit Type Central Office. The system derives its name from the fact that the main operating desk is so arranged that additional circuits may be added to the existing outfit at any time it is desired to increase the number of circuits on the system. Heretofore, the standard police signal operating desk has been built to operate a certain number of circuits and if the city where the desk was installed should grow to such an extent that it was considered necessary to install extra circuits, it was necessary either to buy a new desk for the required number of circuits or to build another central office which would take care of the extra circuits which had been added to the system. With the new unit type desk, which is built on the sectional book case principle, it is only necessary to buy the required number of units to take care of the initial installation. Should the city desire to install extra circuits, these units can be added to the existing desk. The desk being furnished the city of Calgary consists of 8 box units, 1 test unit, 2 flashlight units and 1 stable unit.

Other apparatus supplied the city is as follows:—1 P.B.X. telephone board which will be arranged to handle all telephone calls received by the police department. This will not only give communication between any of the police officials and the city telephone exchange, but will give inter-communication between any two officials or between any patrolmen calling from a street box to any police official. Auxiliary equipment also includes 70 exemplar police boxes, 41 flashlight brackets, complete, 70 6 in. double vibrating gongs, and 29 combination street posts, complete. The posts will be arranged for mounting both the police signal and fire alarm boxes which are located on the same corner. At the top of the post there will be a two-light fixture having a red and a green globe. The red globe will be illuminated at night at all times to indicate location of the fire alarm box, but the green globe will be illuminated only when the central police signal office wishes to call a patrolman to a signal box to receive instructions.

There will also be installed 70 relays for operating call bells and green lights, 1 motor-generator set, a storage battery board and storage battery rack, and 6 telephone sets for the officials' offices.

The central office will be installed by the Northern Electric & Manufacturing Company, while the outside line work, erecting of pedestals, mounting of boxes, etc., will be done by the city. The installation as a whole will be the States. At the present time there is only one other installation similar to the one Calgary is installing, this being at Elizabeth, New Jersey.

Testing of Telephone and Telegraph Lines

A Series of Short Articles Based on the Author's Practical Knowledge and Experience—Applicable to Plant of Any Size or to Any Manufacturer's Equipment

By Mr. T. H. Nicholson

A large proportion of the cost of maintaining telephone and telegraph lines is chargeable to locating and clearing the troubles that inevitably occur on the outside plant due to conditions that cannot be controlled economically, to the extent of eliminating such troubles altogether; so, any methods, either particular or general, that will tend to reduce the cost of locating these troubles, and clearing them, should be adopted as producers of so much revenue. This is true not only of the actual cost of locating and clearing trouble, but also of the lost time on the line where the trouble occurs, either to the owner for tolls, or to the subscriber for service.

If trouble occurs on the lines of an electric light plant the only thing that can usually be done is to go out and systematically search for the trouble. This is due to the numerous multiple circuits on such lines and to the very uncertain condition of them. If they were all known to be fully loaded—that is, with all lamps, etc., turned on, and the various values of the load known, it would be possible to locate any ordinary trouble from the central station by various means, but failing this the electric company is usually foresighted enough to have some data of their lines which will indicate points at which trouble may be expected.

With telephone and telegraph lines it is always possible to know what should be on them, and, as a result, a test can be made to see if this known condition exists, and if not, why; but on the other hand, there are a large number of telephone and telegraph offices in which little or no attempt is made to do this, those responsible preferring to take the cruder method of actually "looking for" the trouble.

It is the purpose of this series of articles to point out methods that can be used to indicate the nature and location of troubles as ordinarily encountered on telephone and telegraph lines. These methods will be explained and illustrated in such a manner that they can be readily combined together so that a complete testing outfit suitable for the largest and most varied equipment can be designed from them, or any one particular testing circuit can be made up for use as desired. The possibility of cutting down the time required to locate and clear trouble by the quick and accurate location of them will be the determining factor in the choice of methods in all cases.

Records

One of the most important aids to the clearing of trouble is an efficient and easily operated system of line records, so much so indeed, that an otherwise perfect maintenance organization is seriously handicapped without them. It is often claimed that modern record systems are so elaborate that they cost more to keep up than would be necessary for additional time spent on troubles cleared without their aid. In some cases of poorly organized record systems this may be true, especially when they are considered as completed when first put into use, instead of periodic inspection being made of them and occasional study to ascertain if any features have outlived their usefulness or if it is evident that some data frequently required is lacking.

It has been found that the card system of records is the most suited to this particular work and the prospective user has a large choice of arrangements to select his outfit from. In general it will be found that a uniform size card will give the best results, especially when a large variety of circuits or groups of lines have to be recorded. By so doing it is possible to have a very flexible and elastic arrangement capable of being redistributed or enlarged when necessary without the user being obliged to transfer information from one set of cards to another. This is especially emphasized to warn prospective users against the too common fault of starting a system with small cards and later finding the necessary information cannot all be included on them.

The 5 x 8 card seems to be large enough for all practical purposes and it can be obtained in a large variety of forms. Nearly all card manufacturers carry this size card in a large assortment of colors and with a choice of rulings that can be made to fit any condition. For large users, of course, it is better to design a ruling that is just what is required and to include printed headings for the guidance of users that would be lacking from regular stock cards.

Information on Cards

For telephone lines the cards should be grouped numerically and corresponding to the line numbers. Each line should have a card and if there is more than one station on the line a separate card should be provided for each, so that information particular to one may be recorded without being confused with any other. The upper part should have the number, name and address of the subscriber, together with details of the substation equipment. A space should be provided for the cable or lead, the conductors, the terminal boxes, the resistance to terminal boxes and to station, and the normal line capacity. Details of central office connections should also be provided for—in short, the complete record of the line. The lower part and back of the card can then be devoted to a record of the troubles that occur on that line, together with the cause of them.

In like manner a card record should be kept of all groups of lines and apparatus such as office trunks, desks, positions, etc. It does not take long, if these cards are made up when lines or apparatus are being installed, to secure the necessary information and much valuable time may be saved, not only to the maintenance force but also to the line or piece of equipment in question, when some trouble arises and it is possible to ascertain at a glance just where such and such a terminal is or what should be on a line.

Auxiliary Information

These cards are augmented in well organized systems by various means, such as by specially prepared or marked maps showing the exact location of terminals, etc. In smaller offices these may simply consist of sketches made on blank cards and filed together with appropriate headings for their identification. These sketches are especially valuable in the case of rural lines or signal system that have many branches. In such cases a complete sketch is made showing the length and resistance of each branch under normal conditions and when trouble occurs the cause can be readily located with the results of a suitable test compared with the data shown on sketch. Some examples of the use of these will be given in later chapters under actual working conditions, as well as some of the other forms of data described.

Apparatus

The success of a testing equipment depends to a large extent on the careful selection of the testing apparatus to be used, and it is certainly the worst part of a plant in which to practice economy by the purchase of unsuitable apparatus or cheap instruments. It is not meant by this that the high

priced and elaborate instruments sometimes found catalogued are necessary, but it often pays to get a reliable make even if it does cost twice as much as apparently similar types of less known makers.

It is difficult to obtain equipment specially designed for telephone testing that is entirely suited for the system it is supposed to represent. The development of the telephone and its associated equipment has not yet reached a stage where the designers can afford to devote the necessary time to a study of this important question, so it is left in the hands of users to work out their own salvation.

In small offices it is usually satisfactory to arrange the testing equipment in the form of a wall set, the apparatus being simply mounted on the face of a panel or perhaps directly on the wall. If keys mounted in individual cases are available this is the better course, as it leaves the wiring open, and easily inspected or changed when necessary. In some pretentious offices a box to mount on the wall may be made up and the apparatus, mounted flush, with coils, condensers, etc., arranged inside.

When it is necessary for the testman to use the testboard all or a greater part of his time, it becomes desirable to have it in the form of a switchboard with a regular keyboard and jack panels. Such a testboard is easily made up from a discarded section of the regular switchboard, or from a branch exchange section. In offices that have a blank end position on the switchboard it can be used to advantage for this purpose, without destroying its value as a regular position when extensions make its regular equipment necessary.

(To be continued).

Storage Batteries in Telephone Work

"The application of storage batteries in telephone systems," was the subject of a paper read by Mr. H. W. Beedle, power engineer, Bell Telephone Company, at a meeting of Montreal Electric Society. Mr. Beedle described the development of the speech transmission circuit, and went on to say that the common battery is used incidentally for many signalling circuits, as it is a convenient source of power, and its low reactance feature prevents the fluctuations due to the operation of relays, etc., reaching the subscribers' receivers when their lines are in simultaneous use.

It would seem that with its advantages, the common battery system should be universally used, but it is found that the investment for the more expensive equipment and attached power plant is not generally warranted in isolated offices of less than 400 or 500 subscribers stations; that is: the increase in fixed charges over the local battery or magneto type of board is greater than the resulting economies in the power supply.

Since a storage battery is not a generator of electric power, but must be restored by returning the power taken out, means must be provided for charging. This is usually a generator driven by a motor or other source of power, but mercury arc rectifiers are often used where the capacity required is less than 50 amperes. Again because of the low reactance of the lead battery it is possible to charge it while connected to the load, as it will absorb the unavoidable irregularities in the current from the generator due to commutation and irregular magnetic field distribution. Special machines are required, however, and they have usually three separate and complete armature windings, and a large number of commutator bars.

Where noise on the system is experienced in spite of these precautions in design, and always in the event of arc rectifiers being used, there is a choke or retardation coil inserted in one lead of the charging circuit, which has the effect of smoothing out the current, at the expense, of course, of efficiency.

The storage of energy possible in the battery is naturally of great importance. The demand or load on the office is by no means constant throughout the day, and it would not be economical to run the charging machine continuously so that the battery would simply act as a low reactance bridge for the circuits, as the average efficiency of the machine would be low. It is therefore desirable to run the charging machine during only those hours when the demand from the circuits added to the current which the battery may properly receive equals or exceeds the rating of the generator. This practice is quite feasible in the larger equipments, but may require modification in some cases on account of the rate basis on which power is obtained. Reliability of the power supply is also to be considered, and where it is questionable provision can be made for the probable interruption by installing additional storage battery capacity.

Excepting what are know as private branch exchange boards, and which vary greatly in size and current demand, there are three general types of common battery switchboards in use:—No. 10 with an ultimate capacity of 1,600 stations; No.1-49 Jack with an ultimate capacity of 5,600 stations; No. 1-92 Jack with an ultimate capacity of 10,400 stations.

The storage battery equipment supplied and considered standard for these boards is as follows:—No. 10 boards—one No. 1 battery: 11 cells, capacity 400 amp. hours; one No. 2 battery: 11 cells, capacity 80 amp. hours; No. 1-49 Jack board: one No. 1 battery, 11 cells capacity 800 amp. hours; one No. 2 battery: 11 cells, capacity 200 amp. hours; No. 1-92 Jack board: one No. 1 battery, 11 cells, capacity 3,200 amp. hours; one No. 2 battery, 11 cells, capacity 200 amp. hours. In all these offices the No. 2 battery is used in series with the No. 1 battery to make up a 22 cell battery in order to increase the current through the subscribers' transmitter circuit, when a long distance connection is established.

Private branch exchanges are small switchboards in many respects similar to and in a few cases larger than those mentioned above as standard common battery boards. While conditions sometimes require that they be equipped with a power plant, they are usually supplied over ordinary cable pairs, No. 22 gauge, from the central office to which they are connected.

In case an individual plant is installed a storage battery is included just as in a central office, and where power is required in any considerable amount or the requisite cable pairs are lacking a floating storage battery is installed at boards fed from a central office. The purpose of this floating battery is to equalize the demand for current from the central office; the battery discharging during the day and re-charging at night when the load is at a minimum on the private branch exchange.

Message Taken "in absentio"

Engineers of the French Government telephone system have recently made some interesting experiments, with a view to avoiding inconvenience to persons who are absent from their offices or domiciles when others desire to communicate with them by telephone.

The experiments were made with a certain number of subscribers on the Wagram Exchange at Paris, to whose telephonic apparatus was fitted a special magneto. On turning the handle of this magneto a lamp lights automatically at the desk of a special employee who on receiving the signal, cuts off the connection with the subscriber's number, receives all the calls himself and notes down such communications as persons calling up that subscriber in his absence are willing to give him. On the return of the subscriber,

another turn of the handle of the magneto notifies the special operator that the subscriber can receive further calls, and all communications received during his absence are immediately transmitted to him.

The engineers state that the system is technically a great success, and the question of putting the trials to practical effect by offering the same advantages to all subscribers is under earnest consideration.

Automatic Telephones in Australia

In 1912 the first automatic telephone switchboard was installed in Australia, the work being carried out under the supervision of a representative of a United States firm, to whom is due the credit for the introduction of the system to the Commonwealth. Gellong, in Victoria, was selected by the authorities for the initial experiment. As the result of the satisfactory working of that exchange, 20 suburban exchanges near Sydney are to be similarly equipped and there is every probability that before 1913 has closed still further expansions of the automatic service will be inaugurated.

The Bell Telephone Company have increased the schedule of wages for their operating staff in Montreal and Toronto. The rates vary from $7 per week for beginners to $10.50 for senior operators; $12 to $15 per week for supervisors, senior supervisors, and night chief operators; and from $16 to $22 per week for chief operators.

The Ocean Telegraph Act

A bill was given its first reading at Ottawa on May 5th, providing for more advantageous telegraphic communication between Canada, the United Kingdom and other parts of the British Empire. The bill provides for the appointment of a board to be known as the "Government Ocean Telegraph Board," which shall consist of the Postmaster General, the Minister of Marine and Fisheries, the Minister of Railways and Canals, and the Minister of Public Works. This board shall have charge of the enforcement of the new act.

The text of the bill includes an agreement made with the Universal Radio Syndicate, of London, Eng., for radio-telegraph communication between the above British possessions. This syndicate shall erect the necessary wireless stations and inaugurate a social, press, commercial and government service. The rates for messages sent in both directions between Montreal and any part of the United Kingdom are to be as follows:—

(a) Not more than 4d. per word for messages in plain language (not deferred).

(b) Not more than 8d. per word for code messages.

(c) Not more than 2½d. per word for government messages.

(d) Not more than 2d. per word for press messages.

One of the stations is to be built at some point in the province of Nova Scotia or New Brunswick. The syndicate will have an office in Montreal and will transmit at its own expense all the messages between Montreal and this Maritime station. Special rates from all points in Canada to Montreal are given and are outlined in the bill. The government reserves the right to take over these stations at any time.

It is announced by Mr. H. W. Baxendale, managing director of the Universal Radio Syndicate, with whom the above agreement has been made, that although the terms of this agreement do not require the service to be in operation inside of twelve months, it will actually be ready for operation during the early autumn of the present year.

An Unusual Water Power Station

In connection with the construction on the White Salmon River, Washington, 75 miles east of Portland, Ore., of the 20,000 h.p. hydro-electric development it was found necessary by the Stone & Webster Engineering Corporation to establish a temporary hydraulic plant for the purpose of furnishing power for carrying on the work incident to the building of the large plant.

A power flume 9 ft. 3 in. wide, built of wood, diverts water from the stream right through the new 125-foot dam now in process of construction, carrying it to a point a few hundred feet below the dam where the small wooden power house has been established operating under a 13-foot head of water. The prime mover is a 54-in. turbine built by the S. Morgan Smith Company, and capable of delivering at 13-foot head a maximum of 300 h.p. This is direct connected to a generator rated at 150 kw., 440 volts. The electric power is used for various purposes on the immediate work including quarrying on top of the hill 400 ft. above the dam, operating concrete mixers, lighting, drilling, etc. It is also used at a point more than a mile down the river where the power house is being built, and to which point it is transmitted at 6600 volts. The depth of water in the flume is kept at 6 feet by an ingenious arrangement of gates such that when the water falls below 6 feet a by-pass is closed and the flow is built up; when the water tends to exceed 6 feet the by-pass is opened wide and the excess water thrown into the bed of the stream between the big dam and the temporary power house.

This development will have a head of 175 feet and an impounded volume of forty million cubic feet of water (1,250,000 tons). The water is gathered from a drainage area of 350 square miles and is held back by a concrete dam of the solid gravity type, 470 ft. long with a 250 ft. spillway measuring 125 feet high. Water will be carried from the dam to the power house by a wood stave pipe 5,100 feet long and 13 ft. 6 in. in diameter, emptying into a concrete forebay. From this point two pressure pipes 700 ft. long and 9 ft. in diameter will give the operating head of 175 feet. The purpose of the development is for lighting and power in Portland and vicinity.

Mr. Marshall Resigns

The resignation of Mr. T. F. Marshall as Superintendent of Stations, of the Toronto Electric Light Company, Limited, was marked by a very pleasant and enjoyable evening at his home at 225 Booth avenue, Toronto, when a large and representative deputation of the Operating Department presented him with a leather couch as a token of their regard and regret at the severance of his connection with the firm. The presentation was made by Mr. W. O. Neelands, one of the oldest operators of the firm, who in the course of a few well chosen remarks expressed the feelings of the whole staff at Mr. Marshall's retirement, and cordially wished him and his wife all possible prosperity and happiness.

Mr. Marshall, who was taken completely by surprise, expressed his thanks in a manner which indicated how much he regretted leaving those with whom he had been associated for so many years, and the organization of which he wast justly proud. He referred to the many changes he had seen during his experience with the Toronto Electric Light Company, a period of service which has extended over twenty years. That he should have risen to the high position, which for personal reasons he is now vacating, is the best indication of the esteem by which he is held both by employer and employee.

He related some amusing anecdotes of the troubles experienced from time to time in the development of the system, and the evening was passed in a very pleasant manner by all present.

Electric Railways

Trunk Line Electrification

A valuable paper was recently presented before the American Institute of Electrical Engineers, New York, by Mr. Charles P. Kahler on the subject of "Trunk Line Electrification." A review of which is given herewith. This paper is especially interesting on account of the figures of initial cost and of maïntenance that have been compiled for a typical road. The problem of steam road electrification is one of the biggest that electrical engineers will have to deal with in the next few years.

The great objection to operating many of the large steam railroads by electric power is the extreme heavy investment necessary for the electric apparatus and equipment. The ability of the steam locomotive, to handle railroad traffic in a very reliable, and, I may also say, expeditious manner, is very well known, but up to date, railroad managers either have not been convinced that electric motive power is as reliable as steam power or else they do not believe that the improvement in the railroad service or the saving in operating expenses resulting from electric operation will be great enough to warrant the heavy expenditures necessary. On most railroads, bonds would have to be issued to cover the cost of electrification, and the return on the investment, by reason of the lower electric operating cost, would have to be great enough to pay the interest and sinking fund on the bonds, and leave a reasonable profit besides.

The object of the paper is to show the effect of the substitution of electric motive power for steam, upon the operation of a railroad, and the comparative cost of operating a railroad by steam and electric power; also to outline general railroad conditions and show whether the return on the large investment necessary for the electrification of a steam railroad (by reason of the lower electric operating expenses and increased passenger earnings) will be likely to warrant operation by electric power.

Past Electrification Work

Very little of the past work of steam railroad electrification was done on account of the financial return expected on the money so expended. It was the ability of the electric locomotive to accomplish or do some special work not possible with the steam locomotive that caused most of the past work to be done. The first heavy electric railroad work in this country was on the B. & O. R. R., where the electric locomotives were substituted for steam locomotives to do away with the smoke troubles in the long Belt tunnel extending under the heart of Baltimore. The smoke trouble with steam locomotive has, in fact, been one of the most important reasons for the past progress in heavy electric railroad work. Steam locomotives, with their smoke and gases, could hardly do the work of the Pennsylvania electric locomotives operating through the tunnels into New York. The smoke nuisance is also the principal reason that the electrification of the Chicago terminals is being considered at present.

Irrespective of what caused the past heavy electric railroad work, the actual operation of large electric locomotives showed that they could in some ways handle railroad traffic more advantageously than steam locomotives. Also, it was found that electric locomotives were as reliable in operation as steam locomotives. In fact, the published records of the steam and electric locomotives of the New York Central Railroad, the New York, New Haven & Hartford Railroad, and the Pennsylvania Railroad, indicate that electric locomotives are probably even more reliable in operation than steam locomotives. The published records of the above roads also indicate that the quantity of fuel required to generate power in a steam-electric plant for railroad operation is much less than the fuel required by steam locomotives in the same service. Also, the locomotive repair expense was found to be much less on electric locomotives than on steam locomotives.

Further, as the electric locomotives do not have to bother with taking fuel and water, nor have a boiler or firebox to be cleaned out, they are nearly always ready for service, and also take less time to handle trains that steam locomotives, especially on long runs. The perfection of the multiple unit control made the number of driving units which could be controlled by one man practically unlimited and, consequently, it was possible to make the size of electric locomotives much greater than steam locomotives with the boiler limitations.

The large saving in operation and other advantages which it was evident would result from electric railroad operation, caused the manufacturers and builders of steam locomotives to make many marked improvements in the steam locomotives. The Mallet and Mikado types of locomotive, with all the refinements for economic operation, resulted partly from the competition between the steam and the electric locomotive. However, the limitations imposed by the boiler of a steam locomotive are still a big disadvantage, as any increase in tractive power of a steam locomotive can only be had by lowering the speed.

Another important point in connection with electric operation was brought out by the great success of the interurban electric railways. The frequent passenger train service, and other advantages possible on the electric railways, caused a large increase in the local passenger traffic. The passenger earnings on these interurban electric railways soon after beginning operation became much greater than had been obtained from the same territories by steam-operated railroads.

The gasoline motor car and the gas-electric motor car would probably not have been developed were it not for the trolley lines taking local passenger business away from the steam railroads. These have been successful as far as operation goes, but although some of the published costs of operation are lower than steam train operation, I know of several cases where the operating and maintenance costs of the gasoline motor cars differ very little from those of the three car steam trains. The gasoline cars are not as reliable as a steam locomotive, and I doubt if the gas-electric cars are

much better, although they are probably better fitted to handle traffic where frequent stops are necessary than the gasoline cars.

Effect of the Physical Characteristics of a Railroad on the Operating Expenses

The grades, curvature and other physical characteristics of a railroad have a very important influence upon its operating expenses and are usually very carefully studied by railroad men with a view to cutting down operating expenses. The reduction in the number of freight trains by cutting down the ruling grade is one way of reducing operating expenses. The elimination of helper engine districts, shortening of distances, taking out curvature, and lessening the rise and fall of grades, are other ways in which a great deal of money is now being expended on steam railroads to lower the operating costs.

Ruling Grade—The ruling grades are those which limit the weight of the freight trains. They are not always the maximum grades, because the maximum grades are often momentum grades. On many steam railroads where the average grade is low, the heavy ruling grades which determine the weight and thereby the number of freight trains, are comparatively short. If these roads were electrically operated, the weight of the freight trains could in most cases be made much heavier than possible by steam operation, on account of the characteristic of the electric locomotive to operate overload without dangerous overheating, long enough to get over the short heavy-grade sections, and on this account the ruling grade of an electrically operated railroad will seldom be as great as the ruling grade of a steam-operated railroad. This will be explained more in detail below.

Helper Districts—Sometimes in constructing a railroad on a certain ruling grade, there are some short sections where it is either impossible to build to the established ruling grade or else the construction expense would be prohibitive. In such cases, helper districts are established which require from one to four engines, in addition to the regular road engine, to haul freight trains with the maximum or ruling grade tonnage over them. For instance, if the ruling grade of an engine district is 0.5 per cent. and there is a 1.7 per cent. helper grade, while one engine could haul a freight train loaded for a 0.5 per cent. grade over the engine district, two additional locomotives of the same class as the road locomotive would be required to assist the train over the 1.7 per cent. helper district. Only one engine crew would be required where more than one electric helper locomotive is used, as two or more electric locomotives can be coupled together and operated as a single unit by one man, while with steam locomotives as many engine crews will be needed as there are steam locomotives used.

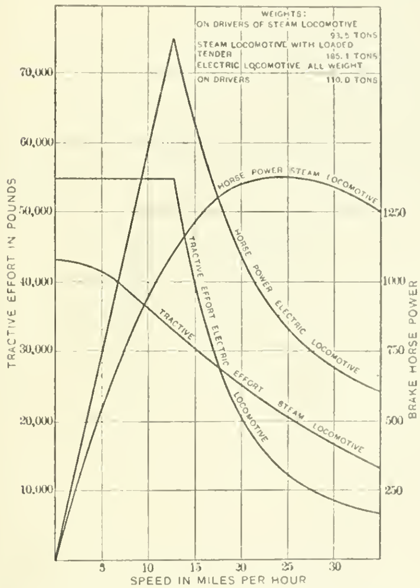
Influence of the Locomotive on the Operating Expenses of a Railroad

The locomotive is directly responsible for from 30 per cent. to 40 per cent. of the operating expenses of a steam railroad. The principal items being the fuel cost, locomotive repair cost, the engine house expenses, and the wages of the engine crew. In addition, the locomotive is indirectly responsible for a good deal of expense, as its tractive power determines the number of freight trains, and upon its reliability depends the expense due to delays from locomotive failures.

The horse power and tractive effort curves shown in Fig. 1, for a consolidated steam freight locomotive and an electric locomotive for freight service, illustrate the comparative characteristics of the two kinds of locomotives. At a speed of 16.5 miles per hour, which is only a little greater than the usual average speed of freight trains, the tractive power of both locomotives is equal. Above this speed the steam locomotive, can exert a higher tractive effort than the electric locomotive, while below this speed the electric locomotive has the higher tractive effort.

The steam locomotive can exert the tractive effort shown by the curve at the higher speeds only for short intervals, on account of the inability of the boiler to continuously supply the necessary steam. On the other hand, the electric locomotive can not continuously exert the high tractive effort shown by the curve at low speeds without overheating. The maximum tractive effort which can be continuously exerted by the electric locomotive with safety is 34,600 lb. at a speed of 16 miles per hour. Below this speed the high tractive efforts shown can only be used for certain periods of time. Thus, for one hour, 45,000 lb. tractive effort can be exerted without overheating the motors, with the speed at about 14 miles per hour.

At starting, as much as 55,000 lb. can be exerted by the electric locomotive, while the steam locomotive can, under favorable conditions, only exert a tractive effort of about 43,000 lb. at starting. One of the causes of the higher power



Curves showing comparative characteristics of electric locomotive and consolidated steam locomotive for freight service

of the electric freight locomotive at starting is that all its weight, 220,000 lb., is on the drive wheels, while although the steam locomotive with loaded tender weighs 185 tons, it has only 187,000 lb. on the drive wheels. Also the coefficient of adhesion is greater for an electric locomotive than for a steam locomotive.

The foregoing shows the characteristics of steam and electric locomotives and should give some idea of their respective abilities to handle the traffic of a steam trunk line railroad. As stated before, the weight of the steam freight trains is generally determined by the ruling grades. As an electric locomotive can exert a high tractive effort for short intervals without dangerous overheating, the average grades, which are usually much lower than the ruling grades for steam operation, have more to do with determining the weight of electrically operated freight trains. Consequently an electric freight locomotive can usually haul much heavier

trains than the steam freight locomotive over the undulating grades usual on most steam railroads.

On some engine districts the weight of freight trains is governed by the starting grades. Here also the electric freight locomotive has the advantage, as all or nearly all the weight is on the drive wheels and the starting capacity of any locomotive is usually proportional to the weight on the drivers.

For passenger service, the higher tractive effort at starting gives the electric locomotive a great advantage, as a higher rate of acceleration can be obtained. Also for local passenger service the higher starting power makes it possible to maintain by electric operation a much higher schedule speed with frequent stops to collect the passengers than could be done with the steam locomotive.

Competition for Different Classes of Railroad Service

The railroad traffic may be divided into six general classes:

1. Suburban passenger traffic.
2. Local or interurban passenger traffic.
3. Through passenger traffic.
4. Local or way freight traffic.
5. Through or drag freight traffic.
6. Manifest or time freight traffic.

The construction of electric trolley lines parallel to steam railroads in many parts of the country, and the operation of electric motor cars at frequent intervals, diverted nearly all of the first and second classes of traffic from the paralleling steam roads. As the trolley cars can accelerate quicker than the steam trains, they can consequently maintain the same schedule speed and still make numerous stops for collecting passengers. The cost of operating the trolley lines range from 12 to about 22 cents per car mile for the one motor car trains, while it takes from 50 cents to $1.40 per train mile for steam operation. Consequently, the interurban electric lines can not only maintain a better service than the steam roads, but also they can afford to charge less fare than the steam railroads, and, as a result, they get nearly all the local passenger business and in addition create a new class of traffic. It has been demonstrated many times that an electric line will, on account of the better service it maintains, get a much larger local passenger traffic out of a territory than a steam railroad usually does.

At the present time the electric lines in many places are handling, with considerable success, a good deal of local freight business. The electric lines have not as yet materially affected that part of the revenue of steam roads which is obtained from the through passenger and freight traffic.

The experience with the electric locomotive has demonstrated its reliability. The operating cost data available from electrified steam railroads have made it evident that many steam railroads could now be operated more economically by electric power. However, the comparative economics of steam and electric railroad operation would, of course, have to be studied for each case, and to bring out the relative advantages and disadvantages of steam and electric operation of trunk line railroads a concrete example will now be discussed.

A Typical Installation

The writer then considers at length the requirements of a typical western road taken arbitrarily as 467 miles in length and divided into three engine districts, respectively 167, 160 and 140 miles long. Electric operation is supposed to be at 11,000 volts, single phase, 15 cycles with 110,000 volts, 15 cycles, high tension lines supplying power to fourteen substations. The local passenger trains are calculated to consist of two electric motor cars and one trailer. The through trains are to be hauled by 100-ton electric locomotives. The local freight trains are to be hauled by an 85-ton locomotive and the through freight trains by 110-ton locomotives.

The paper deals at length with the number of freight trains required, the number of locomotives, etc., and gives interesting tables in this connection. Probably the most valuable figures however are contained in the estimate of the money needed to electrify the 467 miles of steam road considered. This estimated cost of electrification follows:—

Estimated Cost of Electrification

High tension lines (steel tower) 450 miles		$2,250,000
Trolley and feeder wire:		
3/0 grooved copper trolley, 468 mi. at $650	304,200	
Steel trolley wire, 156 mi., at $320	49,920	
2/0 feeder wire, 468 mi., at $500	234,000	
		588,120
Overhead construction:		
Bracket arm construction, 420 mi. at $1650	693,000	
Span construction, 92 mi. at $2600	239,200	
Steel bridges, 4 mi.	36,000	
Section breaks	6,600	
Additional for curved track, 100 mi. at $300	30,000	
		1,004,800
Track bonding:		
624 mi. at $450		280,800
Substations:		
14 substations, 56,000 kv.a.	$616,000	
3 portable stations, 6000 kv.a. (complete)	96,000	
		712,000
Rolling stock:		
14 motor cars, $18,000	$252,000	
10 passenger locomotives, $45,000	450,000	
43 freight locomotives, $50,000	2,150,000	
11 switching locomotives, $35,000	385,000	
		3,237,000
Changing block signals and telegraph (468 mi.)		561,600
Engineering and supervision, 5 per cent.		431,716
Contingencies, etc., 10 per cent.		905,964
Total		$9,972,000
Credit for steam equipment:		
140 locomotives	$2,520,000	
241 coal cars	241,000	
14 passenger cars	112,000	
Give credit for, say, about 70 % of new value	2,873,000	2,012,000
Net estimate		$7,960,000

Comparative Cost of Maintenance and Operation

The comparative cost of maintenance and operation by steam and electric power are worked out in detail, the summary of which is given in the following table:—

Summary of Operating Costs

	Steam operation	Electric operation
Maintenance of way and structures	$671,540	$572,096
Maintenance of overhead structures and substations	000	95,710
Depreciation of overhead structures and substations	000	144,084
Maintenance of equipment	1,025,879	619,041
Depreciation of equipment	86,190	64,740
Transportation expense	2,064,800	1,381,187
Taxes		31,551
Totals	$3,848,400	$3,908,409
Annual saving effected by substitution of electric power		$940,000

Return on Investment

The estimated cost of the electrification of the 467-mile railroad considered above was $7,960,000.00 The return on this investment on account of the saving in operating expense was estimated at about $940,000.00 per year. The interest earned on the money used for the electrification of this road would thus be 11.8 per cent. If it is necessary to borrow the money for this purpose, and if it can be obtained at 5 per cent. interest, there would remain a profit to the railroad of 6.8 per cent. of the net cost of electrification.

Besides this increase in the railroad's revenue, it will generally be possible by operating a frequent local passenger train service with frequent stops to increase the passenger earnings and add considerable more money to the net revenue of the railroad. There are very few localities where local pasenger trains are now operated which would not at least add $500.00 per year per mile of line to the gross revenue if frequent interurban cars were substituted for the local steam train. This, of course, will depend upon the density of the population, local conditions, etc. However, the increase in passenger revenue may, under the conditions in many localities, amount to several thousand dollars per year per mile of

line, and is a very important consideration wherever electric operation is proposed. At the rate of only $500.00 for the 467 mile railroad considered, the increased passenger revenue would amount to $233,500.00 per year, which would add materially to the revenue resulting from electrification.

Conclusions

As stated at the beginning, the great objection to the electrification of steam railroads is the heavy expenditure involved, while the chief reason for considering the electric operation of steam railroads, aside from some special conditions at local points, was to increase the net earnings of the road. It was further stated that the answer to the question of whether the increased net earnings which would result from the electric operation would be great enough to pay interest on the cost of electrification, and besides leave a profit, could only be had by making a careful investigation of each individual road.

The example taken above was not chosen to favor electric operation but was taken to show actual conditions. It will be noted that the quantity of traffic asumed was comparatively small, which of course does not favor electric operation. The data given above, which will be found similar to those on many steam railroads, show that the traffic on many of the trunk railroads now operated by steam locomotives could be more economically handled by electric locomotives. The fact that, electrically operated, the road considered above could handle the same traffic with about 25 per cent. less train mileage and locomotive mileage than when operated by steam, and with 15 per cent. less ton mileage and about half as many locomotives as are needed for steam operation, is certainly deserving of serious consideration.

The overload characteristic which makes it possible for the electric locomotive to haul heavier freight trains over the short heavy grade sections than can be done by steam locomotives was illustrated above, and would indicate that considerable money now expended upon grade reductions of steam railroads would not be warranted if the road were electrically operated.

There has been considerable discussion lately as to the advisability of each railroad company building a power plant of its own, or else purchasing power from a central power company for railroad operation. One advantage of purchasing power is that the load factor of the large power companies' plants is usually high, whereas on most railroads now operating by electric power the load factor of the railroad power plants is generally low and, consequently, cost of generating power in the railroad plants is high. However, on the other hand, the load factor of a long trunk line will probably be high and the advantage of high load factor in a power company's plant will in many cases disappear.

The most important advantage in favor of railroads purchasing power for electric operation is that the heavy investment necessary for electrification would be reduced. It appears to me that the relative advantages of purchasing or generating electric power will have to be determined by local conditions. The competition between various railroads would, of course, be a very important consideration and is probably one of the principal objections to the purchasing of power from central stations. However, if a long time contract could be made with a power company at a low rate, it would have many advantages.

Another important point is suggested in connection with the electrification of steam roads and supplying electric power for same, which should be mentioned before closing this paper. At many points in the country, large steam-electric central stations have been constructed and at the present time the amount of coal hauled from the mines to these central stations has become very large. It is also absolutely necessary that nothing delay the delivery of coal to the central stations, as the business of a whole community could be easily tied up if the electric power supply was cut off. Consequently, if in providing for future power at such points as Chicago and New York, steam electric plants be constructed at suitable points in the vicinity of the coal mines of Indiana, Illinois and Pennsylvania, and high tension lines be constructed from these new plants to Chicago and New York, the providing of additional railroad facilities for power plant coal hauling would not be necessary. Also, the present steam plants would insure a power supply at the distributing points during the short interruptions which occur on high-tension transmission lines.

The advantage of this arrangement to the railroads would be that if the high-tension lines were constructed upon the right of way of the railroad lines, the railroads could obtain electric power for their sub-stations, when the roads were ultimately electrified, without the heavy expense of constructing high tension lines of their own. The question as to whether the railroads should own the whole or a part of the power companies, is, of course, a matter which will have to be determined by local conditions.

Where water power is plentiful, as is the case in many sections of the West, the advantage of being able to tie in isolated hydroelectric plants located at points where there is only a small market for power to a network of high-tension lines on the railroad rights of way extending to localities where there is a market for power is evident. Also the chief objection to the electrification of steam railroads (the heavy first cost) would be made of lesser importance by this arrangement.

Street Car Ventilation

In the design of a street car ventilating system the question of fresh air intake is most important both as regards the number and size of the openings as well as their location. Experience has demonstrated the fact that best results are obtained with the intake openings located toward the centre of the car body and this is especially true with double truck cars designed for double end operation. A moving car tends to force the air away from the front end while a vacuum effect is produced at the rear. This air movement causes the dust of the street to be drawn away at the front and carried in toward the rear end. Observation has also shown that the dust stirred up by the car tends

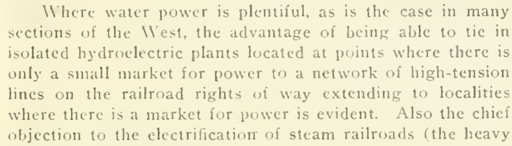


Diagram showing direction of air movement

to rise to the level of the car body toward the rear while the space between the trucks is comparatively free from dust.

The Vacuum Car Ventilating Company of Chicago have met the demand for street car ventilation by placing on the market a mechanical system of air removal. A motor driven exhaust fan is located at one end in the car roof and draws the air from an exhaust chamber built in the car roof and extending the whole length of the car. To provide a fresh air supply a series of openings are made in the floor of the car body immediately below the car heaters (see figure). This provides for the proper temperature of the air. The vitiated air passes upward and enters the exhaust chamber at the top of the car through a series of registers. The exhaust fan creates a partial vacuum in the exhaust chamber

in the car roof resulting in a steady upward flow of air from the car body.

The cross section of the area of the openings under the heaters has been carefully considered as well as their location. These are so designed that the temperature rise shall be the greatest possible. The distribution and quantity of air is also such that there is no appreciable draft to cause discomfort to the passengers.

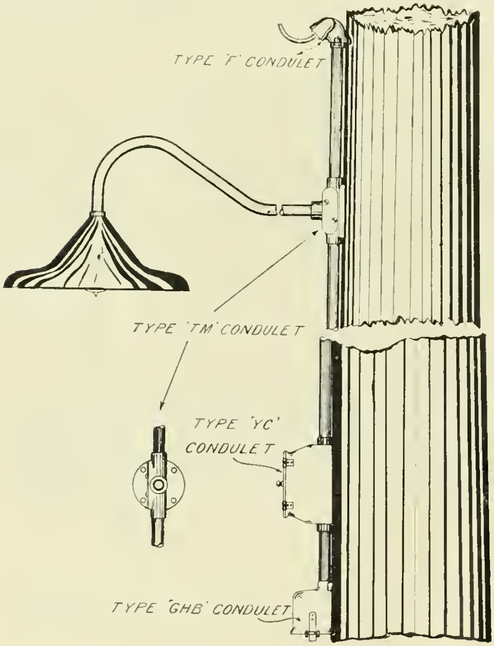
The motor used to drive the fan is designed for 600 volt service, series wound, with steel frame fully enclosed. It requires less than 1 amp. operating at 1950 r.p.m. Under ordinary conditions the motor operates under a load of less than one-half h.p.

The standard equipment manufactured by this company has been designed to provide a circulation of air of from 500 to 600 cubic feet per minute through the car body. If required, larger amounts of air can be moved, but it must be borne in mind that special provision has to be made for heating this extra amount to a comfortable temperature.

Condulet Suggestions for Lighting Railway Yards

The illustration herewith shows a condulet installation used as standard by the Transcontinental Railway Company in their railway yards at Transcona, Manitoba.

A type F condulet is used at the top of the pole for receiving the wires. This is a three-piece fitting composed of a clamping ring, cast iron body and porcelain cover. It provides for the proper separation and installation of the wires. The wires are then extended down through the conduit into a type TM condulet which is a combination of pipe flange and type T condulet, cast in one piece, and is very compact and strong. This fitting is designed to take the various combinations of covers and is generally used, as in this case, for pipe lamp brackets.



A good outdoor wiring installation

The conduit is continued down the pole to the YC condulet, which fitting consists of a one-piece cast iron body, sheet steel hinged cover, and an adjustable cut-out fastening plate. This fitting is designed for main line cut-outs through feed, with enclosed fuses.

At the bottom of the conduit installation on the pole is installed a QHB condulet which is designed for standard thumb knob snap switches to protect the switch and wiring from the weather. The fitting is made weatherproof and is arranged so that the cover of the condulet may be secured by a small padlock and thereby prevent unauthorized persons from tampering with it.

The above installation is in actual use in the Transcontinental Railway yards at Transcona, Manitoba, and from the report we have received from Mr. E. J. Young, electrical engineer for the government, we understand that this installation has proven very satisfactory and that they have adopted the same as their pole lighting standard. The material was supplied and the installation designed and installed by the Crouse-Hinds Company of Canada.

Electric Railway for Ladysmith, V.I.

While on a visit to Vancouver early in May, Capt. Montague Yates, general manager of the Vancouver Island Hydro-Electric and Tramways Company, Limited, announced that all preliminary arrangements have been completed in connection with the construction, by his company, of an electric street railway system at Ladysmith, Vancouver Island, the necessary provincial right having been secured and an agreement with the city endorsed by the ratepayers. It is understood that work is to commence immediately and that an interurban system extending to Chemainus, Duncan, Nanoose and Nanaimo will eventually be put in operation. It may be recalled that this company was unsuccessful last year in an attempt to secure a charter for the construction and operation of a street railway system in the city of Nanaimo.

An Engineering Congress

Announcement is made that in connection with the Panama-Pacific International Exposition which will be held in San Francisco in 1915, there will be an International Engineering Congress in which engineers from all parts of the world will be invited to participate. This engineering congress will be conducted under the auspices of the five following international engineering societies, namely:—American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Society of Civil Engineers and the Society of Naval Architects and Marine Engineers. These societies acting in co-operation have appointed a permanent committee of management who will have charge through their various sub-committees of the different departments of the work entailed by a convention of such importance. The scope of the congress has not yet been definitely determined, but it is hoped to make it widely representative of the best engineering practice throughout the world, and it is intended that the papers, discussions and proceedings shall constitute an adequate review of the progress made during the past decade, and an authoritative presentation of the latest developments and most approved practices in the various branches of engineering work. The various committees are now actively at work and more definite announcement can be looked for in the near future.

The Convention of the Canadian Electrical Association is held in Toronto, June 25, 26 and 27

Illumination

Remote Control of Lamps

Electricians are frequently called upon to arrange switches in certain rooms of private residences so that lights in other rooms can be turned on or off by means of them regardless of the switches in the rooms where the lamps are located. Where this is the only condition to be fulfilled the task is an easy one; a three-point local switch and another switch of the same kind at the point of remote control is sufficient. Once in a while, however, it is required that the arrangement be such that certain lights, or all the lights in the house, can be turned on by means of a switch in some particular room, and that they cannot be turned off with any other switch while this switch is kept closed. Sometimes, for example, the owner of the house may want to be able to flood the rooms with light at will by closing a switch in his bed room, and to keep the light on until he opens this switch again. Several schemes for accomplishing this have been worked out, but some of them require an arrangement of

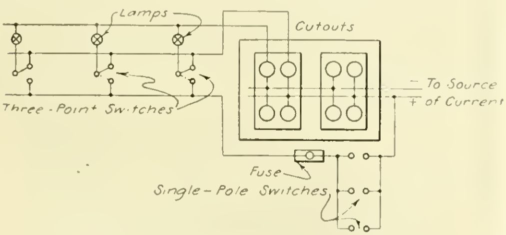


Diagram showing remote control of lamps.

circuits which the average electrician is liable to find confusing. The scheme illustrated in the accompanying figure, appears in a current number of the Electrical Review, and is interesting for its simplicity.

By reference to the figure it will be observed that the lamps in the outlets shown are controlled locally with three-point switches instead of the usual single-pole switches, and one point of each switch connected to a third wire paralleling the two wires of the lamp circuit. Single-pole switches are connected as shown. There may be as many of these as is desired and they may be located in any places convenient. There could easily be one of these single-pole units in each bed room in the house, for example, so that in case of an emergency, such as a burglar invasion, the occupant of any room could immediately light up the whole house. In the figure the single-pole units are shown close together, to save space.

The three-point switches would usually be of a standard type, and each switch would be located in the room where the lamps it controlled were. When the single-pole master switches were all open the lamps could be turned on and off with the three-point switches. But while a master switch is closed all the lamps will keep burning regardless of whether the three-point units be turned so as to complete the circuit along the heavy or along the dotted lines shown connecting the points of the switches.

To keep from confusing the figure but one lamp circuit is shown, but it is a simple matter to adapt the arrangement to a house having any number of circuits. To make the system as complete as possible keyless lamp sockets of such a type that the lamp can be locked in place may be used.

New Rules for Low Voltage Work

The new Rules and Regulations just placed in force in Ontario by the Hydro-electric Power Commission with reference to "Low Potential Work," follow. Any circuit which develops a potential below 650 volts is considered as coming under this heading:—

General

a. Wires, when entering cabinets, must be protected by approved bushings, which fit tightly the holes in the box and are well secured in place.

The wires should completely fill the holes in the bushings, so as to keep out dust; tape may be used to build up the wires, if necessary. In concealed knob and tube work, approved flexible tubing will be accepted in lieu of bushings, provided that it extends from the last porcelain support into the cabinet.

b. Wires must not be laid in plaster, cement or similar finish, and must never be fastened with staples.

c. Must not be fished for any great distance, and only in places where an inspector can satisfy himself that the rules have been complied with.

d. Twin wires must never be used except in conduit or where flexible conductors may be necessary.

e. Conductors must, where exposed to mechanical injury, be suitably protected.

When crossing floor timbers in cellars, or any rooms where they might be exposed to injury, the wires must be attached by their insulating supports to the under side of a wooden strip, not less than one-half inch in thickness, and not less than four inches in width. Instead of running boards, guard strips on each side of, and close to, the wires will be accepted. These strips are to be not less than seven-eights of an inch in thickness, and at least as high as the insulators.

Protection on side walls must extend not less than five feet from the floor, and must consist of substantial boxing, retaining an air space of not less than one inch around the conductors, closed at the top (wires passing through bushed holes), or approved metal conduit or pipe of equivalent strength must be used.

When metal conduit or pipe is used, the insulation of each wire must be reinforced by approved flexible tubing extending from the insulator next below the pipe to the one next above it, unless the conduit be installed according to the rules on conduit wiring and the wire is approved for conduit use. The two or more wires of a circuit, each with its flexible tubing (when required), must be placed within the same metal pipe. Special permission for deviation from this last requirement may be granted in the case of direct-current circuits.

In damp places, wooden boxing may be preferable, be-

cause of the precautions which would be necessary to secure proper insulation if metal pipe were used. With this exception, however, metal piping is considered preferable to the wooden boxing; it is especially suitable for the protection of wires near belts, pulleys, etc.

f. Wires, when run in roof spaces, will be considered as concealed, and when run in close proximity to water tanks or pipes, will be considered as exposed to moisture.

Wires in such spaces are considered as exposed to mechanical injury, and must not be run on knobs on the upper edges of joists.

Open Wiring

a. Wires must have an approved rubber, slow-burning weatherproof, or slow burning insulation.

A slow-burning covering, that is, one that will not carry fire, is considered good enough where the wires are entirely in insulating supports. Its main object is to prevent the conductors from coming accidentally into contact with each other or anything else.

Where rubber insulation is used and covered with a flame-proof or other braiding, such braiding, or flame-proofing must be stripped back on all wires or cables, a sufficient amount to give the necessary insulation distances for the voltage of the circuit on which such wires are used. This requirement applies with equal force to joints in wires or cables, or where such conductors are sweated into connectors or lugs.

b. Sub-bases of incombustible, non-absorptive, insulating material, which will separate the wires at least one-half inch from the surface wired over, must be installed under all snap-switches used in exposed knob and cleat work.

Concealed Knob and Tube Work

a. All wires must have an approved rubber insulating covering.

b. Wires must be rigidly supported at a distance of at least one inch from the surface wired over, and must be kept at least five inches apart.

They should preferably be run singly on separate timbers, or studding, and must be separated from contact with walls, floors, timbers, and partitions, through which they may pass by tubes of incombustible, non-absorptive, insulating material, such as glass or porcelain. Wires passing through the cross timbers in plastered partitions must be protected by an additional tube extending at least four inches above the timber.

At distributing centres, outlets or switches, where space is limited, and the five-inch separation cannot be maintained, each wire must be separately encased in a continuous length of approved flexible tubing.

c. When, in a concealed knob and tube system, it is impracticable to place the whole of a circuit on incombustible supports of glass or porcelain, that portion of the circuit which cannot be so supported must be installed with approved metal conduit, or approved armoured cable; except that if the difference of potential between the wires is not over 300 volts and if the wires are not exposed to moisture, they may be fished if separately encased in approved flexible tubing, extending in continuous lengths from porcelain support to porcelain support, from porcelain support to outlet, or from outlet to outlet, and wires must, except where taps are necessary, be in continuous lengths, without joints, throughout.

d. When using either conduit or armoured cable, in combination with concealed knob and tube work, the requirements for either conduit work or armoured cable work, must be complied with, as the case may be.

e. Wires must, at all outlets, except where conduit is used, be protected by approved flexible tubing, extending in continuous lengths from the last porcelain support to at least one inch beyond the outlet.

The proper finishing of wires at outlets is of great importance, more especially when used in conjunction with gas pipes.

From the last insulator to a point below the finish of ceiling, each wire must be separately enclosed in continuous approved flexible tubing, and some suitable method must be adopted to prevent this tubing from becoming detached from the wires. Taping them to the gas pipe is not approved, as it may be necessary to twist or screw out the gas pipe at some time; this might seriously injure the wires, or water might lodge between the tubing and the pipe, and lead to trouble.

The use of two outlet boards set on an angle of 90 degrees is regarded as reliable and satisfactory, and its use is advocated, unless an approved device is used which will effectually clamp the flexible tubing in place.

Where gas is used, the flexible tubing must be long enough to reach below the grounded portion of the insulating joint.

When the surface at any outlet is broken, it must be repaired, so as to leave no holes or open spaces at such outlet.

When it is impracticable to insert the outlet boards described above, as might be the case in knob and tube work installed after plastering or decorating is completed, wooden base blocks, not less than three-fourths of an inch in thickness, securely screwed to lathing, must be provided for switches, and also for fixtures which are not attached to gas pipes or conduit.

It is suggested that approved outlet boxes be installed at all outlets in concealed knob and tube work, the wires to be protected by approved flexible tubing, extending in continuous lengths from the last porcelain support into the box. In such cases the wires must be protected in the manner described above.

Interior Conduit Work

a. No rigid conduit tube having an internal diameter of less than five-eighths of an inch must be used. Measurement must be taken inside the conduit.

b. Must be continuous from outlet to outlet or to junction boxes or cabinets, and the conduit must properly enter, and be secured to, all fittings, and the entire system must be mechanically secured in position.

In the case of service connections and main runs, this involves running each conduit continuously into a main cutout cabinet, or gutter surrounding the panel board, as the case may be.

Where lock nuts are used to secure conduits to outlet or other boxes, there must be one on each side of the wall of the box which will secure the conduit to the box without depending upon the bushing.

c. Except flexible steel conduits of the built-in type, must be first installed as a complete conduit system, without the conductors.

The dimensions of the conduit and the arrangement of the conduit system as a whole must be such that the conductors may be drawn and withdrawn without injury.

d. Must be equipped at every outlet with an approved outlet box or plate.

At exposed ends of conduit (but not at fixture outlets), where wires pass from the conduit system without splice, joint or tap, an approved fitting having separately bushed holes for each conductor is considered the equivalent of a box.

Outlet plates must not be used where it is practicable to install outlet boxes.

The outlet box or plate must be so installed that it will be flush with the finished surface, and, if this surface be

broken, it must be repaired so that no gaps or open spaces will show around the edge of the outlet box or plate.

In buildings already constructed, where the conditions are such that neither outlet box nor plate can be installed, these appliances may be omitted by special permission of the Inspection Department having jurisdiction, provided that the conduits ends are bushed and secured.

It is suggested that outlet boxes and fittings having conductive coatings be used in order to ensure better electrical contact at all points throughout the conduit system.

e. Metal conduits, where they enter junction boxes, and at all outlets, etc., must be provided with approved bushings or fastening plates fitted so as to protect wires from abrasion, except when such protection is obtained by the use of approved nipples, properly fitted in boxes or devices.

f. Must have the metal of the conduit permanently and effectually grounded to water piping, gas piping or to a suitable ground plate. If connections be made to gas piping, they must be on the street side of the meter.

If the conduit system consist of several separate sections, the sections must be bonded to each other, and the system grounded; or each section may be separately grounded, as required above.

Where short lengths of conduit (or pipe of equivalent strength) are used for the protection of exposed wiring on side walls, and such conduit, or pipe, and wiring, is installed, as required by Rule "e," "General," "Low Potential Work," the conduit or pipe need not be grounded.

Conduit and gas pipes must be securely fastened in outlet boxes, junction boxes and cabinets, so as to secure good electrical connection.

If conduit, couplings, outlet boxes, junction boxes, cabinets or fittings, having a protective coating of non-conducting material, such as enamel, be used, the coating must be thoroughly removed from threads of both couplings and conduit and also from surfaces of boxes, cabinets and fittings where the conduit or ground clamp is secured in order to obtain the requisite good connection.

g. Pull-in and junction boxes must always be installed in such a manner as to be accessible.

h. All elbows or bends must be so made that the conduit or lining of same will not be injured.

The radius of the curve of the inner edge of any elbow must not be less than three and one-half inches on rigid conduit, nor less than one and one-half inches on flexible conduit or armouring. Conduit must not, for draw in systems, have more than the equivalent of four quarter bends from outlet to outlet.

i. Wires used in conduit must have an approved rubber insulating covering, and must, within the conduit tubing, be without splices or taps.

Attention is here drawn to the fact that insulating rubber covering, for use in unlined conduits, must be double braided.

j. In all sizes larger than No. 12 B. and S. gauge, wires must be stranded.

Exception may be made in straight runs, if without any bends or offsets, where larger solid conductors could evidently be drawn and withdrawn without injury.

k. Conductors must not be drawn in until all mechanical work on a building has been, as far as possible, completed.

Conductors in vertical conduit risers must be supported within the conduit system in accordance with the following table:—

No. 14 to 0 every 100 feet.
No. 00 to 0000 every 80 feet.
No. 0000 to 350,000 c.m. every 60 feet.*
350,000 c.m. to 500,000 c.m. every 50 feet.
500,000 c.m. to 750,000 c.m. every 40 feet.
750,000 c.m. every 35 feet.

The following methods of supporting cables are recommended:—

1. A turn of 90 degrees in the conduit system will constitute a satisfactory support.

2. Junction boxes, in which insulating supports of approved type must be installed and secured in a satisfactory manner, may be inserted in the conduit system at the required intervals, so as to withstand the weight of the conductors attached thereto. Such boxes must be provided with proper covers.

3. Cables may be supported, in approved junction boxes, on two or more insulating supports so placed that the conductors will be deflected at an angle of not less than 90° and carried a distance of not less than twice the diameter of the cable from their vertical position. Cables so suspended may be additionally secured to these insulators by tie wires.

Other methods, if used, must be approved by the Inspection Department having jurisdiction.

l. Must have the two or more wires of a circuit drawn in the same conduit.

Special permission may be given to deviate from this rule in the case of direct current conduits if compliance with the rule be impracticable in some particular instance.

m. The same conduit must not contain more than four two-wire, or three three-wire circuits of the same system, except by special permission of the Inspection Department having jurisdiction, and must never contain circuits of different systems.

Moulding Work

a. The use of wood moulding is not permitted.

b. For metal moulding, wires must have an approved rubber insulating covering, and must be in continuous lengths from outlet to outlet, or from fitting to fitting, no joints or taps being made in the moulding.

Where joints or taps are necessary, fittings, approved for the purpose, must be used. Under this rule, wires having a single braiding with a waterproof finish may be employed.

c. Metal mouldings must not be used for circuits carrying more than 1,320 watts.

d. The two or more wires of a circuit must be installed in the same moulding as required for conduit.

e. Must be continuous from outlet to outlet, to junction boxes, or approved fittings designed especially for use with metal mouldings, and must at all outlets be provided with approved terminal fittings which will protect the terminal insulation of conductors from abrasion, unless such protection is afforded by the construction of the boxes or fittings.

f. Where passing through a floor must be carried through an iron pipe extending from the ceiling below to a point five feet above the floor.

This will serve as an additional mechanical protection and exclude moisture often prevalent in such locations.

In residences, office buildings and similar locations, where appearance is an essential feature, and where the mechanical strength of the moulding itself is adequate, this ruling may be modified to require the protecting pipe from the ceiling below to a point at least three inches above the flooring.

g. Backing must be secured in position by screws or bolts, the heads of which must be flush with the metal.

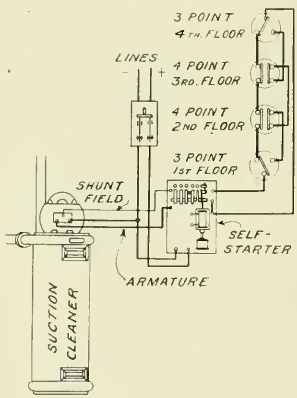
h. Must be grounded and bonded in the same manner as required for conduit.

The general rules under conduit must be observed, that is to say, the metal of the moulding and gas pipes must be securely fastened at outlet boxes, and where metal mouldings, couplings, etc., have protective coatings of non-conducting material, such coatings must be thoroughly removed from the surfaces of boxes, fittings, etc., at the point where a ground clamp is secured, and wherever else it may be necessary to make other good bonds or connections.

The Dealer and Contractor

Control of Stationary Suction Cleaners

The diagram shown herewith indicates how a direct current motor operating a stationary suction cleaner may be controlled from a number of different points through a self-starter. The self-starter is operated by means of an electro-magnet which gains in strength as it cuts out the resistance of the rheostat. In the drawing, control is shown from four points but it will be seen that this could be extended to any number. The upper and lower positions require three point switches and the intermediate positions, four point switches. As shown, the current is on, but it



Motor control from any floor

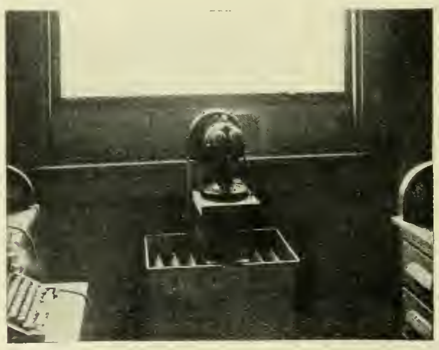
will be seen that a movement of any one of the four switches would open the circuit whereas a further movement of anyone of the switches would again close the circuit. This means that if the motor is not running it can be started by a simple turn of the switch at any one of the four positions, and if the motor is running, it can be stopped by turning the switch at any one of the four points. This arrangement, it will be observed, does not prevent interference from some other floor if the motor has been turned on or off at any particular floor.

Office Ventilation at Small Expense

Every grown person needs 3,600 cubic feet of fresh air every hour. Without this amount of pure air, we labor under a burden that lowers the vitality and reduces the efficiency for accurate work by an amount proportional to the decrease in the air supply.

Take the case of an office 14 x 20 feet and 11 feet high, which contains about 3,080 cubic feet of air. To supply each of four occupants with 3,600 cubic feet of fresh air per hour, the air must be completely renewed about six times per hour or a little oftener than once every ten minutes. It is evident that it would take a pretty stiff draft blowing through a 5 ft. window raised 3 inches to secure this ventilation. In the winter, coat collars would be turned up, fur collars put on, and there would be four pairs of cold feet. But ventilation can be secured in a better way. If a small motor-driven blower is arranged with piping so that fresh air is drawn from the outside and delivered against a steam radiator, the air will be warmed and delivered in a gentle current which will not cause any discomfort and yet the room will be warm and the air fresh.

Such an arrangement is shown in the illustration, where a Westinghouse general utility motor driving a Sirocco blower is mounted on a stand directly over a steam radiator. The intake of the blower is piped with a gate between it and the board set in the window to give access to the outside air; the outlet delivers the air at the top of the radiator. The air is prevented from blowing along the floor by a galvanized iron box which surrounds the radiator on all sides, extending from the floor to the top of the radiator, but open at the top. Thus the cold air is delivered at the top of the radiator in a downward current, and before it can find its way out of the box again, it must rise around the radiator and become warmed. The blower shown is capable of supplying 175 cubic



Proper office ventilation by motor control

feet of air per minute, or 10,500 cubic feet per hour, a sufficient supply for three persons. The natural ventilation provided through the opening of doors, around the edges of the windows, and in other ways is sufficient for an additional person. The action of the blower will also tend to stimulate the action of the radiator; the cold air cools the radiator, condenses the steam and causes a fresh supply to enter, thus increasing the circulation of steam and causing the radiator to give out more heat.

Automobile Starting and Lighting

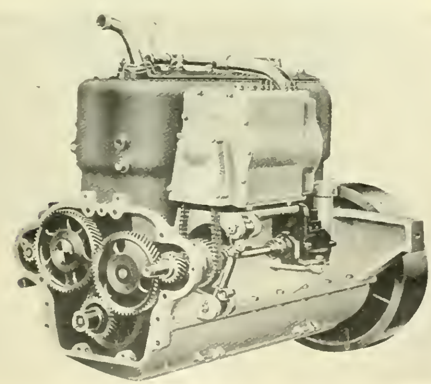
One of the most difficult questions confronting automobile manufacturers to-day is the selection of a simple and dependable system for starting and lighting. The electric starting system has now become so generally used that it may be considered as standard so that the problem resolves

itself into the selection of the best of several systems available.

The illustration shown herewith refers to the "Entz" system, which has been recently placed on the Canadian market by the Adams-Bagnall Company, through Mr. R. E. T. Pringle. The motor is shown in Fig. 1 in the front of the figure and close to one side of the cylinders of the engine. It will be seen that the power from this motor is transmitted to the magneto shaft by a silent chain and thence through timing gears to the crank shaft which it spins swiftly and continuously until the engine is started. The principle on which the system operates is not greatly different from the general system of electric start. The motor is so constructed that it can operate as a generator when occasion requires. Both functions of starting and lighting are performed by this unit. When used as a generator it produces current for charging a storage battery and for lighting the car. When used as a motor it is being driven by the storage battery and is used to start the engine.

The storage battery consists of nine cells of two volts each. This battery floats on the line in such a manner that the motor changes to a generator and back again to a motor according as the voltage rises above or falls below that of the battery. After the engine is started and reaches a certain speed, the voltage of the motor becomes greater than that of the battery, at which point the motor becomes a generator and the battery is charged at all higher speeds at a definite governed rate. The control of the generator output is accomplished through the character of its design without the assistance of any automatic devices.

One switch centrals the starter, but there are three switch positions—the "off," "on" and "neutral." In the "off" position the starter is disconnected and the magneto is short circuited so that neither the starter nor the ignition system are in operating condition. When it is required to At this moment the motor begins to operate and the magneto short circuit is broken. As soon as the motor speeds up the engine starts firing and runs under its own power. In the "neutral" position the magneto short circuit is still broken but the starter is disconnected. This position is used

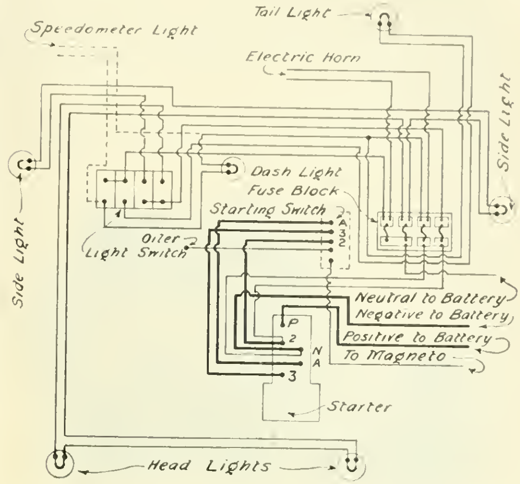


Showing self-starting motor attached to engine

on long tours or at abnormally high speeds over a considerable distance. When at the "neutral" the generator stops charging the battery.

The same battery is used for both starting and lighting, but the two circuits are independent. When the starter first operates, the engine is turned over from 100 to 150 times per minute. The starter will even propel the car for a considerable distance.

Fig. 2 represents the wiring diagram for this system of car starting and lighting. All the cells are charged in series and discharged through the motor in series. The two head lights are seven-volt type which are also connected in series and draw current from the first six cells. The side lights are similarly connected. The tail and auxiliary lights are connected across the last three cells, using six volts.



Wiring diagram of lighting and self-starting equipment

The dimensions of the motor are approximately as follows:—Length over all, 13¾ in.; width, 6⅞ in.; height, 9¾ in; weight, 85 lbs. The generator is geared to run at 2½ to 3 times the crank shaft speed.

Large Steam Plant

Contracts for a steam plant of 60,000 kw. capacity have been placed recently in New York by Messrs. Guggenheimer and Company, New York, for the Chile Exploration Company. The equipment at present comprises four 10,000 kw. Siemens generators coupled direct to four 14,300 P.S. Zoelly Steam Turbines of Escher Wyss & Company, Zurich, manufacture. These units will run at 1500 r.p.m. when working with steam of 170 lbs. pressure and 325 Centigrade superheat. Escher, Wyss & Company, Montreal, who are attending to the American business of their works, Zurich, have secured this order against competition from the foremost American and European makers, on the strength of the low steam consumption of their turbine. The plant is to be installed in Chile and the power used for electric smelting of copper ore. The transmission line, which is of 200 miles in length, will be for 110,000 volts pressure. Messrs. Siemens Schuckert Werke have been awarded the contract for the whole of the electrical equipment.

The Federal House of Commons have given a third reading to the bill of the Quebec Rapid Transit Railway Company. The company is authorized to construct and operate electric lines running from Quebec City in an easterly direction through Limolou and Beauport, thence northerly through Charlesbourg, Riviere Jaune, Lake St. Charles and Indian Lorette, also taking in Ste. Foy, Cape Rouge and Montcalmville. Another line will run from St. Gregoire to Ste. Anne de Beaupre, crossing from thence the St. Lawrence to the Island of Orleans and circling the Island. The company is also empowered to construct a bridge from the North Shore to the Island. The capital stock is one million dollars.

Weston Miniature Direct Current Instruments

A light compact and portable instrument for the measurement of current or e.m.f. is today recognized as a necessity. It is not, however, an easy task to design and construct an instrument of this type so that it will be accurate, durable and reliable. The Weston Electrical Instrument Company, after making many models, and expending a large sum of money in designing special tools, fixtures and devices, have developed a line of miniature instruments of the permanent magnet movable coil type for the measurement of current and voltage.

A special effort has been made by the manufacturers to enable them to offer a complete line in both portable and switchboard types. They are now able to furnish voltmeters,

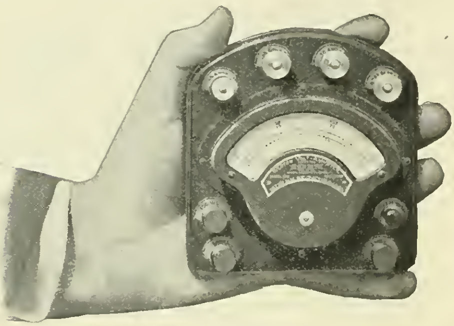


Fig. 1—Volt-ammeter

ammeters, volt-ammeters, special battery testing voltmeters, and milli-ampere meters. Single, double and triple range instruments may be obtained, in various combinations. Dull black Japan with nickel trimmings is the standard finish. These instruments are carefully made, and are very compact. They weigh less than a pound and may easily be carried in the pocket. The pointer of the portable form is knife-edged to permit close reading. The scale length is 2¾ in.

The movable system of these instruments is extremely light, weighing less than 0.2 gram (less than the weight of two common pins). This system is magnetically damped, and comes to rest quickly after the application of current. In fact not more than about 1/5 second will elapse before

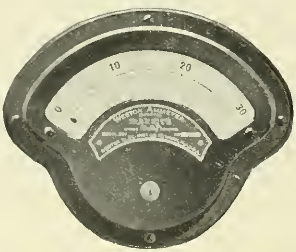


Fig. 2—Volt meter or Ammeter

the pointer comes to rest in any new position due to changes in current or e.m.f. Both portable and switchboard types are shielded against external magnetic fields and are practically unaffected by changes in temperature.

Fig. 1 shows a triple range portable volt-ammeter which is just one-half actual size, the outside dimensions actually being 4.4 by 4.6 inches. With this instrument any e.m.f. from 150 volts to 0.02 volts, and any current from 30 amperes to 0.05 ampere may be measured. These miniature instruments serve many useful purposes. In high schools and colleges the results obtainable with them are more than equal to class room and laboratory requirements, and their low price permits their extensive introduction, so that each student working in a laboratory may be provided with an instrument. Experimenters and amateur electricians working in wireless and other lines, will find that one of these instruments will meet their requirements, and the accurate quantitative results obtained will encourage the user to attempt more difficult work. Wire chiefs in telephone and telegraph work, railway engineers and many others who must carry instruments, to perform general testing or inspecting, will appreciate the light weight and compactness of these instruments.

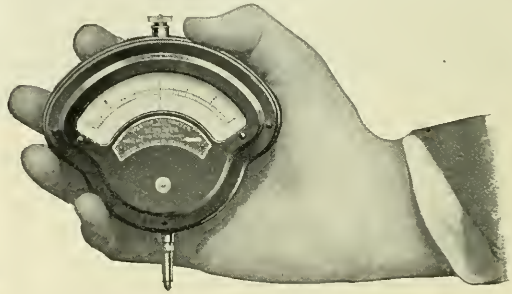


Fig. 3—Battery Testing Volt meter

The miniature switchboard meter shown on Fig. 2 is also one-half actual size. The movements in these instruments are practically identical with the portable models, but a pointer with a pair-shaped tip is used to permit readings at a considerable distance. These instruments are all single range and back connected. They are made in numerous ranges from 50 milli-amperes to 30 amperes, and from 50 milli-volts to 150 volts. These instruments are especially useful in all cases where small size and weight are important factors, and with the advantage of low first cost, serve excellently in connection with automobile self-starters or head-light batteries, small isolated plants, apparatus for physicians use in electro-therapeutics, dental work, etc.

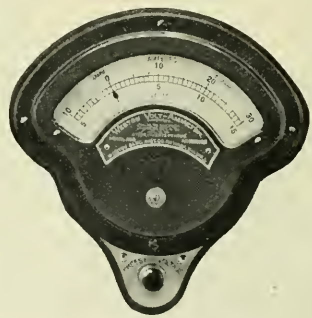


Fig. 4—Volt-ammeter

Fig. 3 represents a battery testing voltmeter, one-half actual size. These are provided with a steel point at one terminal which is removable and may be replaced by a regular binding post nut. To the other binding past may be attached a flexible cord with another point supplied with the instrument. The pointer is of the knife-edge type and the scale is preferably figured with zero in center so that the voltage of any coil may be determined without reversing connections.

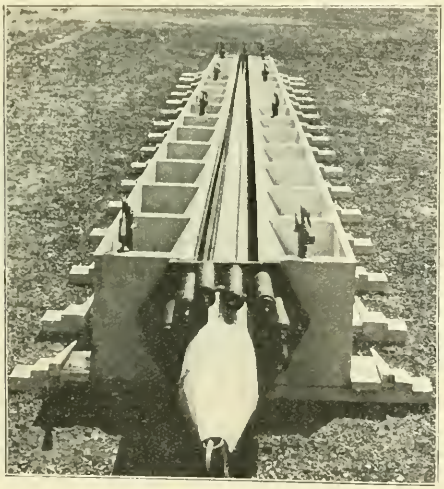
Fig. 4 illustrates a switchboard volt-ammeter, designed specially for storage battery charging outfits, for automobiles

and other small installations where it is necessary or preferable to use one instrument to indicate both volts and amperes. Normally it indicates the charging or discharging current but when pressure is applied to the contact button the pointer will indicate volts.

Hollow Concrete Poles

The National Reinforced Concrete Corporation have issued an interesting booklet describing the manufacture of reinforced hollow concrete poles. The illustration herewith shows the form with the core in place ready to run in the concrete. The reinforcing rods are shown with plate and long cylinder washers with stretcher bolts on both ends on the rods in place and for stretching these rods. The core shown is started when the concrete has set sufficiently that it is just possible to make an impression with the finger and is removed about 6 in. to free from binding, after which it is left for several hours and then removed. After forty-eight hours, or long enough for the concrete to become hard enough to hold the tension of the reinforcing bars, the stretchers are released and the sides of the form taken from the pole. The pole is removed from the base after four or five days. The following remarks of this firm regarding concrete poles, are of interest.

The ever-increasing demand for electric light and power, and the wide development of electric traction, as well as the wonderful increase in telegraph, telephone and signal service, has caused engineers to look for a suitable substitute for wooden poles, which have proven unsatisfactory on account of their short life, due to the action of the elements. Wood preservatives to delay decay have been used, but on account of the expense of treating the entire pole, the cost exceeds the benefit of additional life attained.



Form for moulding concrete poles

Steel poles and towers have therefore come into general use for power transmission lines, but these require frequent painting and are not only expensive as to first cost, but require considerable attention to prevent corrosion.

Properly designed reinforced concrete poles can be made to attain the necessary strength, and as in the case of steel poles, they can be set at greater distance apart than wooden poles. The fire resisting qualities of concrete is equal to, or greater, than that of steel. Reinforced concrete poles can be readily modified in outline and have a pleasing appearance, due to the natural gray of the concrete, which can be given any other color if necessary, and ornamented as desired. The hollow passage in the interior of the poles may be used to carry wires to the ground, and thence in any direction to the basements of buildings or to conduit systems.

Many engineers have doubted that such a long, slender structure would be able to withstand severe strains without cracking. Properly designed poles do not crack, and moisture is excluded by means of a proper concrete filler used on all poles exposed to frost or damp. The handling of these poles has been carefully worked out, and poles up to 35 and 45 feet long have been loaded, handled and unloaded in the same manner as wooden poles.

In places difficult of access, we claim that our pole is superior to all others, as our system of moulds lends itself readily to the manufacture of the pole immediately adjacent to the place of erection. It is much cheaper to haul the materials and make the pole on the ground, than to haul the pole itself, except possibly by railroad companies. In many instances the above method of construction will enable the engineer to use reinforced concrete poles at lower cost than steel or wood.

The cost of taking up slack in lines supported by wooden poles, which sway about in heavy wind and loosen the wires, requiring frequent readjustments; also the cost of restringing wires every ten years when wooden poles decay and have to be removed, has proven a great expense. Concrete poles do not sway in the wind on account of their great weight and the wires remain free from slack for a greater time. The appearance of the concrete pole does not change with age, requires no painting and will not burn.

Reco "One-day" Time Clock

The Reynolds Electric Flasher Manufacturing Company of Chicago and New York are now placing on the market a neat, compact, inclosed-in-iron-cabinet, one-day Time Clock. The size is 10 in. x 4½ in. x 5 in. and the clock may be installed in any convenient place inside or out of doors, as the case is weather-proof. The clock is of standard make, especially designed for this work and requires no other attention than daily winding. The switch mechanism is mounted on a porcelain block and the tripping arrangement is simple, yet effective and thoroughly reliable. The cabinet has a door at the back, which permits easy access to all of the winding levers, switch set, wiring, etc. The switch was designed after much fore-thought and a close study of conditions, with a decision to make a strong, practical and simple device, selling at a reasonable price. This switch is suitable for turning off electric signs, show-window lights, store or hall lights, apartment house lights, isolated street lights, patrol alarm systems, etc.

One-day type time clock

The Utilities Committee of Kingston will ask the Hydro-electric Power Commission of Ontario to submit estimates on the cost of an interurban electric railway between this city and Cornwall.

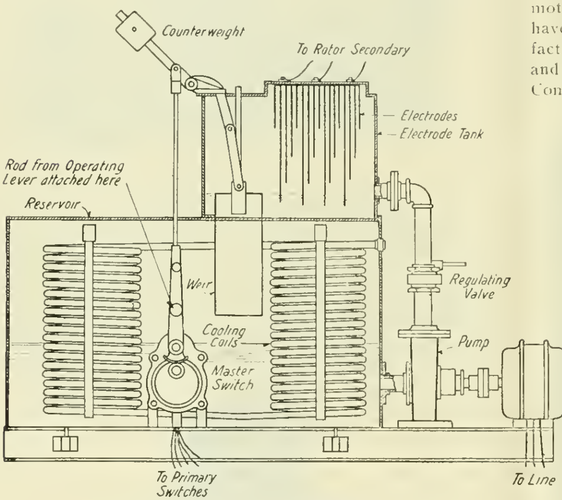
Liquid Rheostats for Large A.C. Motors

The use of large alternating-current slip-ring motors for driving mine hoists, winding gears and rolling mills, etc., has increased largely during the past few years and has created a demand for a simple, efficient and economical controller. To meet this demand the Westinghouse liquid rheostat has been developed.

These rheostats provide an infinite number of steps between the minimum and maximum limits, thus permitting fine speed adjustments and very smooth acceleration. The rate of acceleration can be definitely fixed and in independent of the rate at which the operator manipulates the starting lever; it is then impossible to injure the motor or the machine it drives by too rapid acceleration.

The entire apparatus is very simple in construction and very reliable in operation. There are but very few parts susceptible to wear or deterioration and these can be easily and cheaply renewed.

The principle of operation of these rheostats is clearly shown by the accompanying diagram. The rheostats consist of two compartments, an upper tank for the electrodes, and a lower reservoir. The three phases of the rotor are



Diagrammatic sketch of liquid rheostat

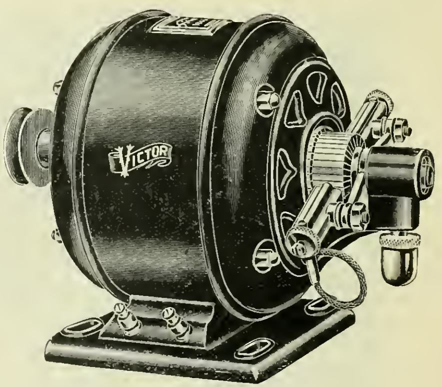
connected to the electrodes suspended in the upper tank. A small motor-driven pump pumps a steady stream of liquid, usually a solution of soda, from the reservoir into the electrode tank, and back into the reservoir over a weir. Now by raising or lowering the weir, the height of the liquid in the electrode tank is correspondingly varied. The resistance in the rotor circuit decreases as the liquid level rises, and vice versa, and the motor speed, of course, changes with the rotor resistance.

The primary circuit of the motor is opened and closed by means of electrically-operated switches, which are controlled by a master switch mounted on the rheostat. The operating lever on the rheostat controls both the master switch and the weir. When the lever is in its central, or off, position, the primary switches are open and the weir at its lowest level, so that the secondary resistance in maximum. Moving the lever in one direction closes the proper primary switches for starting the motor forward and raises the weir. Moving the lever in the opposite direction, reverses the motor and again raises the weir. Speed control is secured by varying the position of the weir by moving the lever; the primary switches do not open until the lever is placed in the off position.

A valve in the intake pipe of the electrode tank regulates the rate at which the liquid is pumped in, so that no matter how quickly the operating lever is moved, the liquid can only rise at the rate for which the valve is adjusted, thus fixing the rate of acceleration. When the lever is returned to the off position, the weir drops and the liquid level promptly falls. Cooling coils in the reservoir prevent rapid evaporation of the liquid. These rheostats are made in capacities of from 400 to 1,500 horse power.

Series Type A.C. Motors

Many users and manufacturers of small motor driven apparatus require a variable speed so as to obtain a maximum of efficiency from their machines which has resulted in a constantly increasing demand for small series type motors for operation on a.c. circuits. This variation of speed is obtained by two methods—mechanical control and electrical control. A mechanical control is not so efficient and in certain kinds of apparatus is impracticable. On the other hand electrical control can only be obtained from a series type motor on alternating current, comparatively few of which have been placed on the market on account of the manufacturing difficulties in turning out a thoroughly reliable and durable machine. In this connection the Victor Electric Company have recently brought out a series type a.c. motor, for which they claim that the previous objections have been overcome. They call attention to the practically sparkless commutation of their motor which they say is so perfect that it can be favorably compared with the commutation of direct current motors.



Victor variable speed motor

The motors are built in two sizes—1/8 and 1/6 h.p., and are designed for operation at 110 or 220 volts at 25, 30, 40 and 60 cycles. Both these motors are built in the same frame which is approximately 6½ in. x 7 in. x 9¾ in. in size. The field and the armature cores are built up of very thin and specially annealed Swedish iron laminations. The commutator is made of a special copper composition which is tougher and is claimed to wear better than pure carbon. The brushes are moderately wide and flat and are of the highest grade of imported carbon. The motors are finished in black Japan and nickel and are made either semi-enclosed or entirely enclosed.

These motors are specially adapted for the operation of apparatus requiring full torque such as washing machines, vacuum cleaners, or any other device likely to be overloaded for short periods. There are no starting devices. The speed

can be controlled with a separate rheostat similar to that used on direct current motors which does away with the objectionable features encountered where the brushes are shifted. It also gives a maximum of power on the various speeds.

Expansion Chamber of Siemens Oil-Cooled Transformers

It is essential for the reliability of oil-cooled transformers that the oil remain unaltered as long as possible, because one of the chief causes of trouble has been due, until a quite recent date, to the deterioration of the oil through chemical change and formation of sludge. This trouble, which used to start after comparatively few hours of running, has been more and more reduced by careful selection of the oil, assisted by long experience. It was found impossible, however, to avoid this trouble altogether, and impurities in the oil always began to show themselves at some time or other. Further experiments demonstrated the fact that warm oil, if in immediate contact with air, absorbs oxygen from the atmosphere and begins to undergo a chemical change.

As a result of exhaustive tests the Siemens Companies have re-designed their medium and large transformers in order to prevent the heated oil from coming in contact with the air. This is accomplished by providing a second tank (the so-called expansion chamber) which is connected with the transformer tank by a siphon-pipe. The whole is then filled with oil to such a level that the siphon-pipe is filled with oil, even when the transformer is cold. On account of the siphon-pipe, no circulation of the oil between the transformer tank and the expansion chamber can take place (disregarding for the moment expansion of the oil) so that the oil in the latter remains cold and keeps the hot oil from exposure to the air. The cold oil of the expansion chamber (provided it is a mineral oil) remains practically unaffected by contact with the atmosphere. As the transformer temperature rises, a certain amount of warm oil will expand from the transformer tank past the bend of the siphon-pipe into the expansion chamber, but since this flow only takes place gradually, the heated oil from the transformer is either already comparatively cool when it reaches the expansion chamber, or else cools down quickly after it has entered. The expansion chamber, therefore, only contains oil at low temperature, which remains practically unaffected by exposure to the air. The expansion chamber, in addition to preserving the oil, offers the further advantage of preventing water from condensing on the cover of the transformer.

In the ordinary design, without expansion chamber, the alternate expansion and contraction of the oil causes air to be sucked into, and expelled from, the transformer case. The air, of course, is laden with a certain amount of moisture which condenses on the cover when the transformer cools down suddenly. The new arrangement excludes completely the formation of water inside the casing through condensation. The outlet of the siphon-pipe in the expansion chamber is arranged in such a position that any water which may collect in the expansion chamber cannot enter into the siphon-pipe before the water level in the expansion chamber has reached a certain height. A drain-off screw is provided in the bottom of the expansion chamber by means of which the lower strata of the oil can easily be checked from time to time, so that any accumulation of water can be detected in good time and removed.

"The First Engineers"

The Canadian Allis-Chalmers have issued an unusually attractive calendar, the picture portion showing a colony of beavers at their work and entitled "The First Engineers." This is the emblem uniformly adopted by this company but the present calendar adds "Our Old Friends in a New Light," referring to the fact that the Allis-Chalmers-Bullock Limited have been reorganized under the name of the Canadian Allis-Chalmers, but will continue to carry on the same line of manufacturing.

Trade Publications

Bruce, Peebles & Company—This company have just issued specifications sheet No. 59, dealing with their standard turbo-alternators, in which full information is given with regard to winding insulation, brush gear, ventilation, etc. On the front page of this specification is given an illustration of their enclosed type of machine which is the standard arrangement for all the turbo-alternators of this company with the exception of the two smallest sizes which are of the open type.

Automatic Trolley Guard—A pamphlet issued by the Electric Service Supplies Company, describing a safety contrivance of use principally where overhead trolley lines run across steam railroads at grade. This guard prevents accidents by keeping the trolley wheel on the wire while the car is passing through these danger zones.

Pneumatic Tools—Bulletin No. 34-L of the Chicago Pneumatic Tool Company's Compressor Department. This bulletin is one of the series covering the company's complete compressor line, and treats particularly of general engineering information of value to users of compressed air. It contains tables giving efficiencies of air compression at different altitudes, density of gases and vapors, mean effective pressures and horse powers, loss of pressure due to friction in pipes, and many others, some rare and all important. Also information for intending purchasers, showing the data required for intelligent estimates. Views of various types of compressors are shown in miniature.

New Books

A Laboratory Manual of Alternating Currents—By John H. Morecroft, E.E.; Longmans, Green & Company, publishers. Distributed in Canada and Newfoundland by the Renouf Publishing Company, 25 McGill College avenue, Montreal. Price $2.25. Mr. Morecroft's method of handling the subject matter to be investigated by experiment consists in a careful analysis of the test to be performed, of the different variables involved, their relations to one another, errors likely to be introduced, etc. The idea is that the student should, as far as possible, be made to work out for himself the scheme of connections, meters to be used, readings to be taken, arrangement of data on the record sheet, etc. This is deemed the proper course inasmuch as it is the one that must be followed by the practising engineer who is carrying out any commercial test. The analysis of the action of alternating current meters has been given in more than usual detail and a method for predicting the regulation of an alternator is given in which all the factors entering into the question are logically treated. The experiments described are designed for the use of senior students in electrical engineering and are supposed to parallel and reinforce the lecture course being taken at the same time. The manual is well printed and freely illustrated.

The University of Toronto have awarded the following professional degrees to well-known Canadian engineers:—F. A. Dallyn, the degree of civil engineer (C.E.); E. A. James, the degree of civil engineer (C.E.); C. H. Marrs, the degree of civil engineer (C.E.); D. I. H. Forbes, the degree of mining engineer (M.E.); A. G. Christie, the degree of mechanical engineer (M.E.); E. H. Darling, the degree of mechanical engineer (M.E.); G. J. Manson, the degree of mechanical engineer (M.E.); R. S. Smart, the degree of mechanical engineer (M.E.); P. H. Mitchell, the degree of electrical engineer (E.E.).

Current News and Notes

Brandon, Man.

The first three of the new cars to be operated on the municipal railway lines arrived in Brandon on May 7.

The first car was tried out on May 17, but a regular service will not be inaugurated until about the first of June.

Battleford, Sask.

The Battleford municipal electric light plant are at present installing two 240 h.p. oil engines which will drive two 200-kv.a. generators. The plant is in charge of Mr. F. K. Martin.

Berlin, Ont.

A by-law was carried on May 16, authorizing the double-tracking of the railway system from Wellington street to the Waterloo boundary line. The by-law provides for an expenditure of $30,000.

Brockville, Ont.

The Light & Power Department of Brockville, Ont., are calling for tenders for a cluster light installation along both sides of Main street for a distance of one mile.

Barrie, Ont.

It has been decided to install single tungsten lamp units supported from posts already on the streets, in preference to cluster lights on ornamental standards. This is for the main streets where the arc lights are now in use. It is probable the arcs will be removed to the outlying districts. Mr. J. B. Dougall, chairman of the Water & Light Commission, will have the matter in charge.

Cobourg, Ont.

During the month a number of prominent farmers have been supplied with power and light by the Seymour Power Company.

Caledonia, Ont.

The Grand Trunk Railway Company contemplate the installation of electric lights throughout their station, sheds and yards.

Edmonton, Alta.

Plans have been prepared for about three miles of extension out to the Belmont school. It is the intention to use two Edison-Beach cars.

It has been definitely decided to build about 21 miles of municipal track extensions this summer. The track work has been ordered, as well as 35 single end semi-convertible cars from the Preston Car & Coach Co. The order for rolling stock also includes one dump car to be supplied by the Canada Car & Foundry Company, and a 5,000 gallon sprinkler being purchased in the United States. A new car barn on the north side of the city is almost completed, and it is the intention to erect another on the south side to accommodate 15 or 20 cars and designed for extensions when the requirements of the system demand it.

Fort William, Ont.

A contract has been awarded for poles, spikes, etc., required for street railway extensions, to the United States Steel Products Company of New York.

Galt, Ont.

A petition has been circulated and largely signed by the residents of Ainslie street, Galt, and handed to the Hydro-electric Department requesting that three-light ornamental standards be installed from Colborne street to Concession street on both sides of the roadway.

It has been stated by Mr. Thomas Patterson that he has authority from General Manager Coleman of the Dominion Power & Transmission Company, Hamilton, to say that construction will start in the near future on a radial line connecting Hamilton with Galt, by way of Lynden and Troy.

Halifax, N.S.

The bill to extend the franchise of the Halifax Electric Tramway Company by which they would be allowed to develop electric power at Gaspereaux Falls and to increase their capital from $1,500,000 to $10,000,000, has been defeated in the Nova Scotia legislature. At the same time the city bill to provide for a vote on municipal ownership of the tram system was thrown out.

The Halifax Electric Tramway Company have been given authority, by a recent act, to increase their capital by $500,000. This followed the failure of a previous attempt to reorganize on a much larger scale. Even the smaller increase, however, was strongly opposed by the city council who are in favor of municipal operation.

Hull, P.Q.

The Hull Electric Company has been authorized to construct a spur from a point on its main line between Hull and Aylmer to the premises of the Connaught Park Jockey Club.

Hamilton, Ont.

The application of the Hamilton Street Railway Company for permission to make certain extensions on the streets of the city has been approved by the Railway Board.

The local Hydro-electric Department have adopted the policy of selling household appliances, such as electric toasters, irons, etc., and a protest has been raised by dealers in electrical supplies. It is pointed out by the Commission, however, that there is no intention of cutting prices, and that they have gone into this matter with a view solely to increasing the consumption of electric energy.

Kamloops, B.C.

Tenders will be received to June 12 for water wheels, generators, exciters, transformers and switching equipment for the proposed hydro-electric power plant.

Tenders are called to June 12, for transmission line equipment between Kamloops and the new hydro-electric plant on Barriere River.

Revised estimates of the cost of the new power house and equipment according to the latest plans, show that the total will be in the neighborhood of $212,000. A new by-law will be submitted, authorizing the expenditure of $260,000 for this purpose.

Kemptville, Ont.

Light and power is supplied to this town from a water power on the Rideau Canal at Andrewsville, about 14 miles distant. Power is generated at 60 cycles, 3-phase, 10,000 volts. This plant is now being offered for sale.

London, Ont.

The Parker Car Heating Company, who at present manufacture an economical system of heating for steam cars, announce that they will shortly place on the market an equipment specially designed for electric cars.

The annual report of the London Street Railway Company for the year ending December 31, 1912, showed gross earnings of $306,231 and net earnings of $95,952. These are increases of $26,624 and $9,082 over the previous year respectively. The net surplus available for dividends was $67,041, as compared with $58,026 the previous year. The bond-

ed debt of the company is $575,000. The capital stock stands at $552,000.

Morden, Man.

The Morden Electric Light Plant contemplate building one mile of new pole line on Wardrope and Seventh streets this summer. The company is at present building an office and stock room annex to the power house. Mr. T. H. Forster is manager.

Melita, Man.

On May 17 a by-law was voted on in Melita, Man., giving Mr. R. E. Denny franchise for lighting, heating, power and street railway operations.

Kingston, Ont.

Montreal, Que.

On June 5th the Sons of Jove will hold a rejuvenation at Cooper's Restaurant, Montreal.

Tenders will be received by the Board of Waterworks Commissioners for a 1,000,000 gallon electrically operated pump for the Waterworks Department.

In anticipation of the winter load, the Montreal Light, Heat & Power Company have decided to install two additional 3-phase 13,200 volt cables from Cote St. Paul to the Central Station. The cables will be supplied and installed by the Canadian British Insulated Company, Limited, Montreal.

Mr. W. J. Camp, assistant manager of the C. P. R. telegraph department, Montreal, attended the annual meeting of the association of Railway Telegraph Superintendents at St. Louis, Mo.

Mr. James Bennett, late chief inspector of the Canadian Fire Underwriters' Electrical Department, has resigned his membership of the electrical committee of the National Fire Protection Association, Boston.

May 31st is the date set for opening the first portion of the line which the Montreal and Southern Counties Railway are constructing to Granby, P.Q. This section is from St. Lambert, through Greenfield Park, St. Hubert, Brookline, Chambly Basin to Chambly Canton. A number of new cars are to be put on to this extension of the company's service.

The city of Westmount, P.Q., have awarded a contract for the supply and installation of a large quantity of high tension twin conductor arc lighting cable to the Canadian British Insulated Company, Limited, Montreal. This company will also supply a quantity of low tension twin conductor double steel tape armoured cable to Westmount.

Mr. Lawford Grant, president and managing director of the Canadian British Insulated Company, Limited, Montreal, has resigned his post as managing director to take up an important position with the Eugene F. Phillips Electrical Works, Limited, Montreal. Mr. Grant will, in all probability, retain the presidency of the Canadian British Insulated Co.

The British Columbia Electric Railway Company have awarded a contract to the Canadian British Insulated Company, Limited, Montreal, for 12,500 v. three-phase paper insulated lead covered double steel tape armoured cable. This cable will be laid direct in the ground without any protection—a practice which is common in Europe, and is gaining favor in Canada.

One of the Siemens European companies is supplying two 3-phase transformers each 23,500 kv.a. capacity stepping up to 25,000 volts to the Westphalian Electric Works. These transformers will be used in conjunction with 15,000 kw. turbo-generators recently supplied by the same company. We believe these transformers are the largest that have ever been constructed.

An order for the supply and installation of a three-phase 12,500 v. submarine cable for crossing the St. Lawrence at Lanoraie, has been placed by the Shawinigan Water & Power Company with the Canadian British Insulated Company, Limited, Montreal. The cable will be No. 2 B & S gauge, paper insulated, lead covered and double steel wire armoured, made up to the specification of Mr. Julian C. Smith, M.I.E.E., chief engineer of the Shawinigan Company.

The Shawinigan Water & Power Company have just published a very handsome booklet describing their property and plant at Shawinigan Falls and Montreal. The generating capacity of this company consists of six turbine units totalling 55,500 h.p. in plant No. 1, which is transmitted chiefly at 50,000 volts. In plant No. 2 only two units are installed to date, each of 16,000 h.p. capacity, but the ultimate capacity of this plant is five units, or 80,000 h.p. It will thus be seen that the total generating capacity at Shawinigan Falls will in the near future be 135,000 h.p. The out put from the new station is transmitted at 100,000 volts.

The reorganization of Fred Thomson & Company, manufacturing and contracting electrical engineers, 326, 328 and 330 Craig street west, Montreal, is due to increasing business, and after June 1st the firm will be carried on by a limited liability company under the name of the Fred Thomson Company, Limited. The capital stock is $100,000, divided into 1,000 shares of $100 each. Mr. Fred Thomson, who is known throughout Canada as one of the pioneers in the electrical industry, is the president and general manager; Mr. Clarence Thomson is the vice-president and secretary-treasurer; Mr. H. A. McPhee, superintendent; and Mr. A. Walker, electrical engineer.

The Montreal Council have received eight tenders for enlarging the aqueduct, ranging from over four million dollars to $2,322,560. Under this scheme it is proposed to generate 10,000 horse power, 6,000 of which will be utilized for pumping and 4,000 for lighting the city. The project has been delayed, and this, according to Controller Ainey, will have an important bearing on the present contract with the Light, Heat & Power Company. The Council can cancel this contract at the end of two years from now, but owing to the delay in enlarging the aqueduct, it will be impossible for the work to be done in time to permit the city to inaugurate its own lighting system. The city will thus have to enter upon a second five years' contract with the light company. The city is at present paying $260,000 a year for street lighting with an annual increase of about $20,000.

Mount Forest, Sask.

The Mount Forest Telephone Company will require material for the construction of a telephone system.

Naisberry, Sask.

The Naisberry Telephone Company contemplate the erection of a telephone system, and will require the necessary material. Mr. T. Cochrane is president.

Nelson, B.C.

The finance committee has recommended to the city council that the city guarantee a new issue of Nelson Street Railway Company bonds to the amount of $40,000, with the provision that the system be operated by a board of seven directors, including the chairman of the finance committee and of the fire, water and light committee. It is also suggested that the city should get half the profits, if any, after current expenses have been met.

Ottawa, Ont.

It is reported that construction work will begin on the Ottawa and Morrisburg Electric Railway line not later than the first of June.

Porcupine, Ont.

The Northern Canada Power Company, owning power plants at the Wawatian and Sandy falls, have been experiencing interruptions due to the spring floods in that district.

The plant at Wawatian Falls was the first to be inconvenienced, but it is later reported that the Sandy Falls generators have received considerable damage.

Pleasant Dale, Sask.

The Pleasant Dale Telephone Company are reported to require material for the construction of a new system. Mr. W. R. Wilson is secretary of the company.

Richmond, P.Q.

It is stated that Mr. Jno. R. Hall has sold his power rights on the St. Francis River to the Canada Paper Company, and that the same company have also purchased the rights at Kingsey Falls, also on the St. Francis River. These two falls together are estimated at about 1,500 h.p., continuous capacity. It is said these water sites will be developed and energy transmitted to Windsor Mills to be used there in the factories of the Canadian Paper Company and the Canadian Explosives Limited.

St. Catharines, Ont.

A by-law will be submitted on May 30, confirming an agreement between the Lincoln Electric Light & Power Co., Limited, and the Corporation of the City of St. Catharines, by which the company agrees to light the streets of the city for a term of five years. The type of lamp used is the electric arc of nominal 2,000 candle power, 6.6 amp., 480 watts. At least 100 of these lights shall be used by the city at a rate of $50 per annum. The agreement also contains the proviso that the city may string wires for fire alarms, city telephones or for any other exclusively city purpose on the company's poles.

St. John, N.B.

The St. John Railway Company propose to erect an additional car shed on Wentworth street and to install four additional sidings.

Stratford, Ont.

It is understood that the Bell Telephone Company will have their plans for underground conduit work completed in the near future.

The franchise of the street railway company expires here on June 1. It is understood, however, that the company intend to commence construction operations before that date.

St. John, N.B.

Further evidence has been taken on the objections raised against the construction of a power plant at Meductic Falls by the St. John River Hydro-electric Company. Both fishing and lumbering interests were represented.

Summerland, B.C.

The Summerland municipality at present is supplied with light by a small water wheel of the Pelton type, operating at 30 kw., Canadian Westinghouse, 2-phase, 60 cycle generator. It is proposed either this year or next to increase the capacity by the installation of a 60 kw. generator operated by a Diesel oil engine.

Thornloe, Ont.

The Pioneer Rural Telephone Company has been incorporated with head office at Thornloe in the district of Nipissing.

Tilsonburg, Ont.

The Tilsonburg Electric Car Company, Limited, has been organized to manufacture electric street cars, snow sweepers, sprinklers, etc.

Toronto, Ont.

The Toronto Hydro-electric system called for tenders up to May 22, for vitrified clay conduits.

A committee of five U. S. senators has been appointed to investigate the Niagara Falls power situation in all its phases.

Governor Sulzer, on May 29th, signed the Wagner Bill which repealed a charter granted in 1907 to the Long Sault Development Company, giving power to develop electric energy on the St. Lawrence River. The bill provides that $36,000 be returned to the company for moneys paid out by them.

The Toronto Railway Company have applied for permission to build a car barn on the south side of Queen street nearly opposite Greenwood avenue. The building is to be one storey, brick, with a frontage on Queen street of 100 feet, and with a depth of 360 feet.

The St. Clair Avenue line which is being constructed and will be operated by the municipality, will probably be ready by about the 1st of July.

The Volt Electric Company, Limited, has been incorporated with a capital of $40,000, to manufacture and deal in electrical appliances, devices, etc., with head office at Toronto.

It is stated that the Toronto Hydro-electric Commission will proceed at once with the installation of lights in Todmorden, Dawes Road, Swansea and Runnymede.

The Metropolitan division of the Toronto & York Radial Railway Company's system was opened for Sunday traffic on May 18. The heavy traffic indicated the great need of this service.

The first draft of the proposed agreement between the township of York and the Forest Hill Electric Railway Company has been submitted to council for approval. The company must spend $50,000 during the present year.

According to present indications a valuation of the property of the Toronto railway system and the Toronto electric light system will be secured by the city council from a qualified engineer to assist in negotiations for the purchase of these properties.

Vernon, B. C.

Representatives from the Vernon (B.C.) city council visited Vancouver early in May to report on the cluster lighting system in vogue here with a view to its adoption in Vernon.

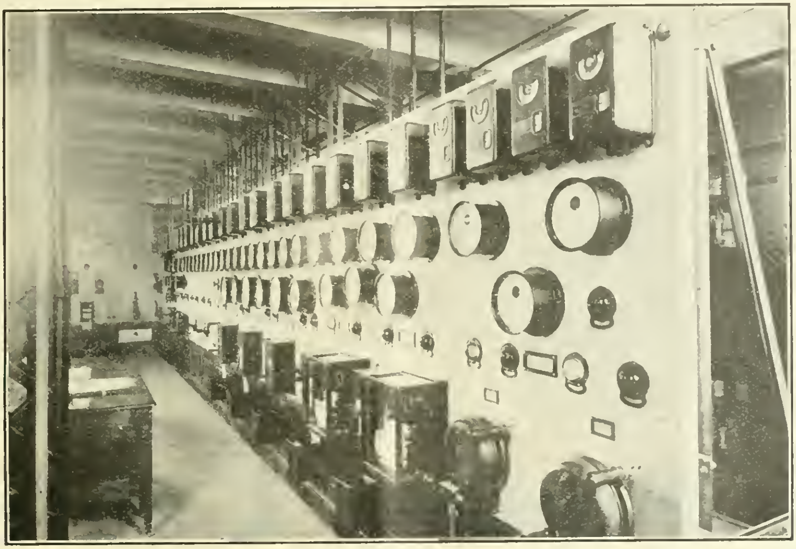
Vancouver, B.C.

The Silver River Power Company, Limited, has been incorporated, head office at Vancouver.

According to advices received from Dawson, Y.T., early in May, the plant of the Dawson Electric Light and Power Company has been completely destroyed by fire, the total loss being estimated at approximately $200,000. The serious nature of the mishap may be gauged from the fact that the plant generated all the light and power for the city, and pumped the water from the entire system of pipe lines furnishing water throughout the district.

The Vancouver City Council recently endorsed a by-law which provides that 25 per cent. of the maintenance of the ornamental cluster light standards installed on certain streets will be defrayed by the city, and in future the property holders will be relieved from paying 25 per cent. of the cost of maintenance and furnishing of light. All ornamental lighting throughout the city will come under the provisions of the by-law as soon as the cost upon which to base the charges has been ascertained. The streets upon which the cost has been definitely calculated are as follows: Main street, $10.30 per 25 feet per year; Cordova street, $7.76 per year per 25 feet; Pender street, $8.52 per year per 25 feet; Hastings street, Main street to Jackson avenue, $7.25 per 25 feet per year.

The question of cheaper power for lighting purposes was discussed at a recent meeting of the Central Ratepayers



Executive, Vancouver, the general feeling being that citizens were compelled to pay too highly. It was pointed out at the meeting that Winnipeg citizens pay 3 cents per kilowatt hour as compared with the prevailing rate of 11 cents in Vancouver. A committee was appointed to investigate the charges for electric light in other cities, and to report their findings to the city council committee that looks after B. C. Electric Railway Company's matters.

Welsford, N.B.

Letters patent have been granted the Welsford and Hampstead Telephone Company to install and operate a general telephone business in the district.

Winnipeg, Man.

An electrically operated pump has just been placed in operation in the waterworks station on McPhillips street.

Tenders will be received to June 5, by the city of Winnipeg for extensions to the terminal station on Rachel St.

A contract has been awarded by the Board of Control to The Crane & Ordway Company, 93 Lombard street, Winnipeg, for galvanized meter fittings.

Walkerton, Ont.

The Walkerton Electric Light & Power Company are at present putting the finishing touches on their dam and power house at Walkerton. The power house is built of reinforced concrete up to the first floor, but above this point it is brick. There are two draft tubes for two main wheels and one smaller tube for the exciter wheel. The exciter turbines may be fed from the pipes supplying either of the larger wheels as desired. Only one water wheel will be installed at present, having a capacity of 235 h.p. at present. This wheel will be controlled by Lombard governor. The generator will be of the Swedish General Electric vertical type, 3-phase, 60 cycle, 2300 volt. The intention is to operate this new machine in parallel with the equipment already installed in the plant. Mr. J. T. Potter is electrical superintendent of the Walkerton Electric Light & Power Company and Mr. A. Richley is construction engineer on this work.

Walkerville, Ont.

The Walkerville Light & Power Company will increase their capital stock from $25,000 to $100,000.

Excavation work has been commenced by the general contractors, DeLisle & Cooper, of Detroit, on an auto-lamp factory.

Yorkton, Sask.

A contract has been let for the construction of the new power house to Messrs. Ritchie & Waters. The building will be of fireproof construction and built of red brick.

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Generation, Transmission and Application of Electricity

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ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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Vol. 22 Toronto, June 15, 1913 No. 12

Our Special Convention Number

While no special effort has been made to feature Toronto in our convention issue, it has happened that a number of interesting developments at present under way in the city have just reached that stage where descriptions are of special interest to electrical readers. As a result this issue contains the description of the unusual equipment being installed in Sir Henry Pellatt's house, a review of the situation with reference to municipal railway extensions which are considerable at the present moment, and also an article of much interest describing the electrical equipment of the new Toronto General Hospital. And in connection with this latter it may be said here that Toronto is apparently becoming the home of quite a large number of isolated generating plants, recent numbers of the Electrical News having described two of them, very modern installations in the head office buildings of the Bank of Toronto and of the Canadian Pacific Railway Company respectively. There is much food for thought on the installation of isolated plants in a city so well supplied with electric energy as Toronto is by both the Toronto Electric Light Company and the Toronto Hydro- electric system, and it would appear that some decidedly convincing arguments must have been forthcoming to justify such expensive and complete private installations, as all of these are, in the face of very favorable central station service conditions. What these arguments may be are not easily evident to the on-looker but these institutions are managed by business men and it is unlikely that sentiment would play any important part in a matter of the kind.

We would also like to draw the attention of our readers to the matter submitted in this issue in our advertising columns. The advertisers include practically the whole field of reliable electrical equipment, each representing in his own particular line the best in the way of manufacturing and manufactured supplies. Much thought and expense has been incurred by our advertisers in placing before you, in an intelligible form, in a few spicy, condensed sentences, the most important features in connection with their products, and the perusal of these pages alone has an educative value that cannot be obtained elsewhere in the same limited space or by the expenditure, on the readers' part of so little time and energy. As Canadians, we are proud to be able to print these important announcements which tell in such emphatic terms of Canada's industrial prominence and stability.

Canadian Electrical Association

Your attention is once more called to the dates June 25, 26 and 27, when the Canadian Electrical Association will meet in convention in Toronto to hear and discuss papers dealing with the various phases of commercial and technical electrical developments of the past year. We understand that matters of importance relative to the reorganization of the association will also be introduced and it is urged that the outcome of this discussion will only be satisfactory in proportion as the attendance is representative and the discussion general and complete.

A cordial invitation is extended to every one connected in any way whatsoever with, or interested in, the electrical industry to attend this convention.

An attractive program of papers has been arranged as follows:—

C. E. A. Convention Programme

1. "Provincial Wiring Rules and National Electric Code," by H. F. Strickland, of Hydro-electric Power Commission of Ontario.

2. "Service," by Stephen L. Coles, of The Society for Electrical Development.

3. "Central Station Advertising," by D. H. McDougall, Assistant to General Manager, Toronto Electric Light Company.

4. "Underground Distribution for Small Cities," by S. Bingham Hood, Toronto Electric Light Company.

5. "Electric Vehicles from the Central Station Point of View," by C. Rummel, Manager Light and Power Department, British Columbia Electric Railway Company.

6. "Electricity on the Farm," by Jno. C. Parker, Mechanical and Electrical Engineer, Rochester Railway and Light Company.

7. "Integrating Wattmeters with Maximum Demand Attachments," by Mr. H. S. Baker, Ontario Power Company.

8. "Flame Carbon Arc Lamps," by T. J. Pace, Westinghouse Electric & Manufacturing Company, Pittsburg.

9. "Electric Heating and Cooking Devices," by Mr. Rowley, of Pacific Electric Heating Company, Toronto.

10. "The Electric Vehicle," by Stephen G. Thompson, of Electric Vehicle Association of America.

11. "Pole Type Transformers," by C. E. Sisson, Canadian General Electric Company.

12. "Magnetite Street Lighting," by W. E. Young, Canadian General Electric Company.

13. "Performance, Repairs, Maintenance and Cost of Operation of Graphic Meters," by G. D. Gratton, Electric Power Company.

The convention will be held in the C. & M. building, College street, of the University of Toronto. Arrangements have been made in the usual way for transportation. Hotel accommodation may be reserved by application to Mr. W. F. Dean, Chairman Hotels Committee, c/o C. G. E. Co., King Street West, Toronto.

Toronto General Hospital Plant

The new Toronto general hospital situated on College street and covering an area of approximately nine acres is claimed to be the most modernly equipped hospital on the continent. While this is true with respect to the equipment peculiarly adapted to hospital requirements it is no less the case from the point of view of its electrical appointments. The following article will outline briefly the installation of electrical equipment and the various uses to which it is put in the various departments of this great hospital.

The various departments of the hospital work will be isolated more or less in their own buildings, all of course, interconnected. The various departments will include the administration, medical and surgical sections, facing on College street and the pathological, emergency and out-patients' sections facing University avenue. The obstetrics building, servants' pavilion, nurses' home, private patients' home and the power house occupy two sides of the square. The hospital has been occupied in part for some time.

The power house building is a brick and fire-proof structure 40 ft. x 136 ft. A brick wall divides the engine and boiler room. The boiler room is 68 ft. x 40 ft. with the floor set 16 ft. below the street level. The ceiling and floor of the engine room and boiler rooms are of reinforced concrete. The plant is now operating very efficiently under the management of Mr. Allan Gibson.

The boiler room contains four Babcock & Wilcox water tube boilers set in two pairs with means of access between them from front to rear. Each boiler has a capacity of 500 h.p. at a pressure of 150 lbs. The boilers are fitted with Murphy automatic stokers and Dutch oven settings. Eight tons of coal can be stored on the top of each furnace. The coal is fed mechanically to the fires by means of two 8 h.p. vertical engines, one being fixed at the extreme end of each pair of furnaces. Both natural and forced draft are used, the latter obtained by means of two steam driven, 90 in. Sturtevant fans. These are automatically regulated by a Bushnell damper regulator.

The coal is carried from the bunkers to the bins on the top of each furnace by means of an electric crane supplied by J. I. Hepburn & Company. This crane is capable of carrying a load of one ton. This crane and the bucket it carries is electrically operated. The same equipment removes the ashes to one end of the boiler room, from which point they are raised by a Turnbull hydraulic lift to the street level and dumped into wagons for removal. The boiler room also contains an incinerator for the disposal of refuse. This was supplied by Heenan & Froude. In this incinerator, provision is made for feeding the refuse which, in general, will be collected in special closed receptacles, through a charging door opening placed on the roof of the furnace immediately over the drying hearth. In this way the refuse will be discharged instantaneously into the furnace without the risk of its coming in contact with the operators.

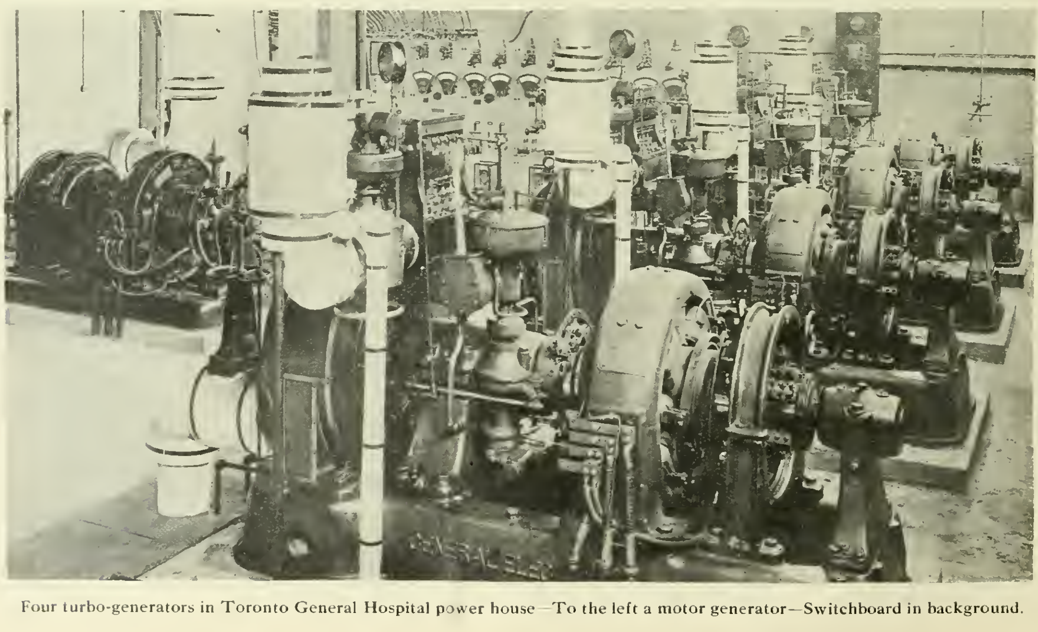
Generator Room

The generating equipment consists of four units of 125 kw. capacity installed by the Canadian General Electric Company. The generators are driven by Corliss non-condensing steam turbines 2,400 r.p.m. at 140 lbs. pressure. The generators are d.c. multi-pole, interpole, three-wire, 250 volt type. The generator armatures are air cooled by fans. There are two air gap commutators on each machine and the two a.c. collector rings are tapped in four places to the coils on that armature. Leads pass from the collector rings to a compensator below the switchboard and the end of each lead connects to a coil immersed in oil. From the centre of this coil a connection leads to the neutral bus, which will care for 25 per cent. out-of-balance load.

There is also installed a motor generator set of 125 kw. capacity, the motor being three-phase, 550 volt, 25 cycles, C.G.E. type. The generator is similar to the other four, a three-wire, 250 volt machine. This will be operated by outside current in emergency.

Switchboard

The switchboard is made up of eight panels, being 5 generator panels and 3 distributing panels, which supply light and power to the various buildings. The board complete, is 20 ft. long by 7 ft. 6 in. high. Each generator panel



Four turbo-generators in Toronto General Hospital power house—To the left a motor generator—Switchboard in background.

carries two ammeters and one watt meter as well as two circuit breakers on the outside leads. The three distributing panels carry one graphic recording wattmeter. At the right of the board is the usual pair of swing voltmeters. Everything in connection with the board was supplied by the Canadian General Electric Company.

The generated power is utilized for lighting the various buildings and also for operating a large number of small motors. When the motor installation is complete, there will probably be close to 60 units, varying in size from 1 to 10 h.p., distributed at various points throughout the building. At the present time there are about 51 motors installed.

The majority of the motors will be used to operate the ventilating and heating system. The heating of the various rooms utilizes both the direct and the indirect method, that is, certain of the rooms are heated directly from the steam coils while others are heated by air which has been warmed by passing over the heated coils. In certain of the departments the air is washed before it is allowed to enter the rooms. For example, in the surgical building there are three sets of air washing equipments and in the administration building three sets; also there is one in the operating room, two in the private patients' department, etc. The air washing sets consist of a motor-driven spraying outfit which keeps water continually sprayed over the air which a second motor, operating a fan, draws in from the outside of the building. This air, having been washed, passes up through the different rooms and is finally exhausted through roof outlets by means of fans installed in small enclosures on the roof. In all, 36 fans are used for this purpose, the sizes varying from 3 to 10 h.p.

In the boiler room two motors are installed, one of 3 h.p. capacity for operating the Yale & Towns electric lift and another of 1½ h.p. for operating the traveller. These are both controlled from the floor.

A properly equipped repair shop will later be fitted up, the various lathes and other equipment being driven by belt from two shafts, each to be driven by a small motor, probably about 10 h.p.

Though the main refrigerating system which will supply ice to the hospital is steam operated, there is one small, approximately one ton, unit operated by a 5 h.p. motor. The motor is Crocker-Wheeler type. The ice to be manufactured will in general, be turned out in 100 lb. blocks, but this will be cut into convenient sizes, as required for use, by a motor driven circular saw. A number of ice cream freezers have also been installed and these too will be operated by a 1 h.p. motor.

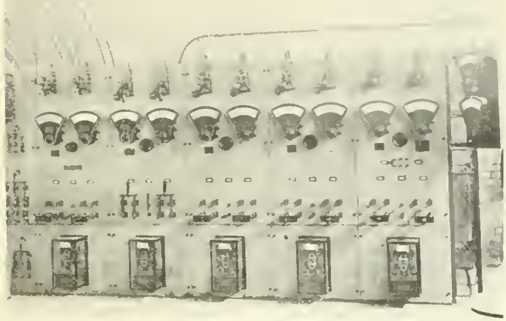
In the kitchen the washing of dishes will be attended to electrically and also in the nurses' home. In each of these two buildings a 3 h.p. motor will be used to circulate hot water among the dishes in an enclosed tank.

The Laundry

The laundry throughout is electrically operated. A battery of washers which operate almost continuously are belted to a shaft driven by a 10 h.p. C.G.E. motor. Two centrifugal dryers are operated respectively by 2 h.p. and 5 h.p. Crocker-Wheeler motors. The clothes are next put into a dry room tumbler operated by a 5 h.p. Crocker-Wheeler motor. The final drying is accomplished in a larger dry house through which air is circulated by means of a ¾ h.p. motor. The largest mangle is operated by a 3 h.p. variable speed Crocker-Wheeler motor. On this machine a Cutler-Hammer control is installed, and an emergency switch which stops and reverses the machine instantaneously. Three smaller mangles are each driven by ½ h.p. motors. The bodies of all these mangles are electrically heated. There is also a collar and cuff ironing machine driven by a 2/5 h.p. motor. In addition the laundry is equipped with ten large electric irons operating on 125 volts. All the motors in the building operate on 250 volts.

The Elevators

The Turnbull Elevator Company have installed eleven elevators in the hospital, all of the direct-connected electric type, the usual worm gear construction of winding machine being adopted. The principal feature of interest in connection with these elevators is the control system adopted on those operating in the medical and surgical wings. These elevators are provided with the usual car switch so that they may be operated by an attendant in the day time, and the usual signal system of annunciator connected to push buttons on the various floors is also provided. Since it was desired, however, to be able to use these elevators at night without the use of an attendant, the control system is provided with a transfer switch so arranged that when this transfer switch is moved from one position to the other, the car switch is disconnected and an automatic control comes into action.



Generator and distributing board, Toronto General Hospital

The pressing of the button at any one of the landings which previously registered a call on the annunciator, now acts to operate the elevator itself and the car automatically travels to the floor on which the button was pressed, and stops there, unlocking the door automatically to allow the waiting passenger to enter.

A gang push button is provided in the car connected in parallel with the buttons on the various floors, and the pressing of any particular button will send the car to the corresponding floor.

An interesting feature of this control system is the means taken to protect against accident through mis-use or ignorance on the part of the person using the elevator, and to protect against interference by other parties when one person has secured the use of the elevator. Safety switches are provided on each door so that the elevator cannot operate unless all doors leading to the hatchway are closed. In addition to this a safety door lock system is provided. This system consists of a solenoid actuated cam on the car, normally extended, which unlocks the door at which the elevator car hapens to be so that a passenger may enter, but as soon as the passenger presses the button in the car or at one of the landings, this solenoid draws back and the door automatically locks itself. The solenoid remains energized whenever the car is moving, even when passing the different floors, with the result that all the doors remain locked until the car arrives at the desired floor and then only the door at that floor is unlocked. The collapsible gates on the car itself are also connected to safety switches so that a passenger cannot operate the car until these gates have been closed, thus protecting occupants from danger due to reaching out of the car in passing a floor, or kicking against the passing floors.

The person using the car is protected from interference by other parties, by the fact that all other push but

tons are automatically cut off by the pressing of any one of them and the circuit established by the pressing of any button is maintained by a corresponding relay on the controller. This relay is connected to a selector, the function of which is to send the car down when the car is above the floor for which the button was pressed, and to send it up when the car is below that floor. This selector also stops the car at its arrival at the floor by opening the circuit to the reversing magnet switch.

General safety has been provided by using a potential switch, which opens the supply line to the elevator in case of drop in voltage, or if any of the ordinary safety devices operate, such as the slack cable switch which opens in case of any slackening up of the cable or crossing of cables on the winding drum, or the over travel limit switch, which would operate if the car were to run beyond the ordinary limits of travel due to failure of the ordinary operating limit switches.

A very complete nurses' call system and powerful X-ray equipments are being installed by Mr. Geo. J. Beattie and will be described in a later issue.

Auxiliary Plant at Penticton, B.C.

The Municipality of Penticton, B.C., has recently put into operation an electric distribution system covering the whole municipal district, comprising an area averaging two miles wide and eight miles long. The district being largely devoted to fruit growing the consumers are naturally somewhat scattered, hence the choice of the distribution pressure of 4600 volts.

Owing to the difficulties in the way of doing the work in the hills the water power plant being installed by the municipality under 2200 foot head, could not be completed in time, consequently an auxiliary plant was decided upon. This has now been completed and has been put into regular operation.

The power house is a plain reinforced concrete structure 35 ft. x 35 ft. x 29 ft. 6 in., situated near the centre of load and surrounded on three sides by a beautiful grove of evergreens. The motive power is furnished by one two-hundred-brake horse-power Mirrlees Diesel engine supplied by the Canadian Boving Company. The engine, which will

Power House, Penticton, B. C.

ultimately be directly connected to a 125 kw. generator, is temporarily belted to one of the generators ordered for the water power plant, the overhung impulse wheel being replaced by a cast steel pulley.

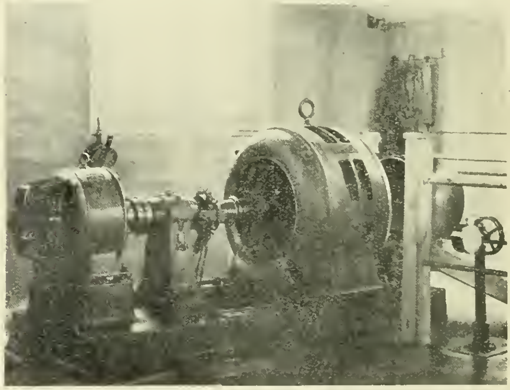
The generator was manufactured by the Lancashire Dynamo Works and is of one hundred kw. capacity at 4660 volts, three phase, 60 cycles, and has its exciter directly connected. The speed is nine hundred revolutions per minute.

The switchboard was supplied by the Canadian Westinghouse Company and consists of three panels of black marine finish slate. The switchboard is also part of the equipment for the water power scheme and includes two generator panels with one main line panel. This switchboard is so designed as to permit of the addition of one exciter panel, two generator panels and one feeder panel in the order named on the right of the present panels.

The generator switches are non-automatic, The station lightning arresters are Westinghouse type "S" low equivalent.

The power house building is laid out to accommodate two 200 B.h.p. direct connected units which will constitute a permanent reserve station for use in connection with the completed water power system.

The fuel oil storage tanks of 10,000 gallons capacity are located one hundred feet away from the power house, con-



Generator and exciter, Penticton, B.C.

venient to a spur from the Kettle Valley Railway and at such level as to permit of unloading the tank cars by gravity. The cars at present come by way of the C. P. R. to Okanagan Landing where they are loaded directly on a car barge and towed to Penticton. On completion of the Kettle Valley Railway through to Vancouver this haul will be considerably shortened.

An interesting feature in connection with the hydro scheme is that the water after being brought eight miles from the hills to the water wheels, will be discharged into the domestic water supply system of the municipality assuring a supply of uncontaminated water.

The distribution system is of standard construction using forty foot poles, single phase primary branch circuits and three wire secondaries. The transformers are Canadian General Electric type "H" and are provided with howitzer type fuses. Owing to the severe lightning storms encountered in this district the lines are protected every mile by Canadian General Electric Company "Multipath" arresters grounded to the water pipes.

The street lighting is by the Westinghouse series adjuster socket system using tungsten lamps from 60 to 200 candle power. The lamps are spaced one hundred feet apart in the business section, and two hundred feet apart in the residential section; the agricultural section is provided with lamps only at corners and dark places.

The service was inaugurated with one hundred and fifty-six connections but is growing rapidly and is now on a sound financial basis.

The plant was officially started by ex-reeve Capt.

Stevens in the presence of reeve Foley-Bennet, the councillors and a representative gathering of the citizens. The service is at present during the night only, a full twenty-four hour service being under consideration owing to the pressing demand for electric power and heat. The pole lines were built by the Penticton Electric Company, composed of Messrs. McDonald and Rowe.

Mr. F. L. McKeever, M.I.E.E., is superintendent. He has had a wide experience in Great Britain, Germany and the East Indies. Mr. F. H. Latimer, C.E., of Penticton, is advising municipal engineer with Messrs. Mather, Yuill & Company, of Vancouver, consulting engineers.

New Ottawa Electric Substation

The Ottawa Electric Company have just opened for operation a new sub-station on Slater street, two views of the interior of which we reproduce herewith. This company has three power houses, two hydro-electric and the third steam turbine driven. Power in the last station is furnished by water tube boilers connected to Westinghouse Parsons turbines. This station takes care of peak loads in winter and may be used in case of accidents or when it is desired to close down one of the hydraulic units. These two stations feed their power into the central station at a generating voltage of 2,200 where it is stepped up to 12,000 volts and transmitted by underground cables to the sub-station on Slater street. At this station it is stepped down to 2,200 and distributed.

Interior Ottawa Electric new substation.

Interior Ottawa Electric new substation.

The Slater street equipment consists of Westinghouse oil-filled water-cooled transformers of 1,500 kv.a. capacity. Sixteen pairs of feeders pass out from this station to different points in the city. The out-going distribution is underground for from 1 to ½ dozen blocks from the sub-stations. This prevents crowding of wires about the sub-station. It also permits of the city east of the Rideau Canal being supplied without a single wire across the New Plaza between the Chateau Laurier and the post office. The new sub-station is of fireproof construction and the equipment is most modern in all respects.

Montreal L. H. & P. Developments

According to the annual report of the Montreal Light, Heat & Power Company, the gross income for the year 1912 was $5,509,556, an increase of $540,302, and the net earnings $3,181,116, an increase of $337,100. After deducting fixed charges, dividends, pension fund and putting $550,000 to depreciation account, a surplus of $627,137 is left to general surplus account, an increase of $128,869. The company improved its operating ratio, which was 42.26 per cent. of gross in 1913, against 42.76 per cent. the year previous. In his report, Mr. H. S. Holt, the president, states:—

"In the electric department your directors during the year entered into a long term and favorable contract with the Cedars Rapids Manufacturing & Power Company for the supply of 60,000 horse-power from their Cedars development to be taken as and when required, and in virtue of the agreement it is incumbent upon our company to transmit the power to Montreal. For this purpose a steel tower transmission line will be completed simultaneously with the Cedars development. Consequent upon the acquisition of additional hydraulic power from the Cedars Rapids Company as intimated, and with a view to maintaining a definite ratio between steam reserve and hydraulic power, your company has planned a new central auxiliary steam station of a capacity of 25,000 horse-power (with provision for an ultimate capacity of 50,000 horse-power) to safeguard the company and its consumers against possible interruptions and variations affecting its hydraulic supply. This station, it is expected, will be ready for operation in October of the present year.

The shareholders, on June 3rd, decided to issue $1,800,000 stock at par, $100,000 of which will be reserved for the employees. The board is composed of: H. S. Holt, president; Sir Rodolphe Forget, vice-president; Hon. Robert Mackay, Sir H. Montagu Allan, Hon. H. B. Rainville, C. R. Hosmer, J. E. Aldred, George Caverhill, Hon. Narcisse Perodeau; J. S. Norris, general manager and secretary-treasurer.

New Books

Rivers and Estuaries—by W. Henry Hunter, M.I.C.E. Longmans, Green & Company, publishers. Distributed through their agents for Canada and Newfoundland. The Renouf Publishing Company, 25 McGill College Avenue, Montreal; price 75c. This is an elementary study of the subject based to a large extent on a series of lectures delivered at the desire of the council of the Institution of Civil Engineers to the students of the institution in various parts of Great Britain and on further lectures on the subject of "Streams and Tides" delivered to the students in the Department of Engineering in the University of Manchester.

497. Electric elevators—An old-established London firm of electric elevator manufacturers wishes to arrange for their sale in Canada.

Ample Power Facilities in Regina

The present plant of the municipality of the city of Regina is located at the corner of Broad street and Dewdney avenue, a whole block being reserved for the generating plant, stores building and incinerator. The power house building has a 37 ft. engine room and 90 ft boiler room. The boiler room is arranged for two rows of boilers facing the firing floor. At present only one row of two batteries consisting of one battery of two 250 h.p. and one battery of two 500 h.p. B. & W. boilers have been installed, but requirements of the city will call for the remaining batteries in the near future. At the rear of the row of batteries now installed and outside the main boiler room is located an 84 ft. chimney; also a 50,000 cubic ft. per minute induced draft fan serving the battery of two 500 h.p. boilers.

In the boiler feed room, 20 ft. x 52 ft., which surrounds the base of the chimney, there are located two sections of 160 tubes each of Green economizers, a 10½ in. x 8 in. x 24 in. Weir feed pump, a 7½ in. x 5 in. x 10 in. Knowles Duplex feed pump, a 7 in. x 5 in. x 8 in. Fairbanks-Morse pump, a Webster class E. C. heater 1200 h.p., and a receiving tank for all the condensed steam of the plant. At the rear of this room is located a spur track for the supply of coal and a small temporary scraper conveyor which carries the coal from the track to a point at the ceiling in the centre of boiler room. The space for future boilers is being used for coal storage at present. A 1,000 ton coal shed is located at one side of the boiler room but is not at present being served by the conveyor, being used only for a reserve supply.

The Engines and Generators

The engine room is served by a 15-ton Whitney crane and contains the following machinery:—

A 22 in. x 30 in. 150 r.p.m. Inglis Corliss engine connected to a 300 kw., 2200 volt, 3-phase, 60 cycle Westinghouse generator with a 10 kw. 125 volt, direct connected exciter on the outboard bearing.

A 11-in. x 20-in. x 14-in. tandem Goldie-McCulloch Ideal engine direct connected to a 100 kw. 2200 volt, 3-phase, 60 cycle Westinghouse generator with a 5 kw. 125 volt, direct connected exciter.

A 500 kv.a. low pressure turbo-generator, 2200 volts, 3-phase, 60 cycle, 3600 r.p.m. to operate with the exhaust of the above two engines. The turbine is served by a C. H. Wheeler condenser consisting of a 3,000 square ft. shell with a 16-in. x 32-in. Rotrex air pump and a 10-in. centrifugal circulating pump driven by a 9-in. x 9-in. Sturtevant engine, both pumps being direct connected with a 1½-in. centrifugal lift pump driven by a silent chain from main air pump shaft elevating condensate to hot well tank in boiler feed room.

A 25 kw. 125 volt, 3500 r.p.m. turbo-exciter is also installed as a standby exciter exhausting into this low pressure turbine when used, the low pressure turbine normally taking exciting current from the exciters direct-connected to engines operating with the low pressure turbine.

An 1875 kv.a. 2200 volt, 3-phase, 60 cycle, 1800 r.p.m. Willans & Robinson-Siemens turbo-generator which is of the combined impulse and reaction type and is served by a Mirrlees-Watson condenser consisting of a 4400 square ft. shell, a 50 h.p. Alley & McLellan engine, being direct-connected to a 14-in. Orten-Boving centrifugal pump and geared to a twin Edwards air pump 18-in. x 10-in., and running at 100 r.p.m. A plunger pump driven from crank on air pump shaft elevates the condensate to the tank in boiler feed room.

Two 400 kw., 800 volt Siemens direct-current generators direct-connected to Belliss & Morcom engines which exhaust into a C. E. Wheeler condenser consisting of a 1300 square ft. shell with a 10-in. x 20-in. Rotrex pump and a 6-in. centrifugal circulating pump driven by and direct-connected to a 6-in. x 6-in. Sturtevant engine, the condensate being elevated to the tank in boiler feed room by air pump without any assistance.

All engines are supplied from a 10-in. steam header which is located on the wall next the boiler room, the header being supplied at two points corresponding to the two rows of boilers, the pipes being arranged so that when the additional rows of boilers are installed it will form a ring. Space is left in the engine room for the future installation of a 1875 kv.a. turbo-generator.

The Switchboard

The switchboards are located at the west side of the engine room farthest away from the boiler room in an elevated gallery supported by steel beams from the floor of the basement and cross channels tied into the west wall of the building. The a.c. board consists of two exciter panels with Tirrill regulator, four generator panels for the control of the four a.c. generators, a spare panel for a future generator and a totalling panel in which power and light are separated with curve drawings and integrating watt meters on each; also oil switch for tying bus-bars together; on the extreme right of the board are six feeder panels on which are mounted 300 ampere, Westinghouse type B, circuit breakers.

The switchboard is arranged with two sets of exciter bus-bars, all exciter and generator fields being fitted with double throw switches, also two sets of a.c. busses with double throw generator switches. Power is taken from the main bus-bar through an oil switch and integrating watt meter to auxiliary bus-bar for all street lights. These auxiliary bus-bars supply current to two 50-light 6.6 amp. Westinghouse air-cooled constant current transformers, four 50-light Westinghouse 6.6 amp. constant current transformers, and rectifiers for metal flame arc lamps.

The d.c. switchboard is of Siemens manufacture, and consists of two generator panels, a totalling panel and three feeder panels. The generator panels are fitted with Siemens reverse power and overload circuit breakers, two knife switches, and an ammeter. The totalling panel is fitted with two voltmeters with plugs, a totalling ammeter and an integrating watt-meter. The feeder panels are each supplied with single pole knife switches, ammeters and plain overload circuit breakers. Distribution is at 2200 volts, 3-phase, 60 cycles, for both light and power, which, however, are kept separate.

Distribution

The lines are located in lanes except where street lighting requires street poles. The street lighting in the main business section is by metal flame arc lamps with Alba globes supported by metal poles spaced 100 feet apart at the curb on one side of a 66 ft. street. An ornamental top has been used on trolley poles wherever these were available and a similar lamp pole has been used with the same design of top for the business streets. The residential districts are lighted by metal flame arc lamps located at street corners and supported by Cutter mast arms on wooden poles, every corner being supplied. 100 Westinghouse 6.6 amp. alternating current lamps are also used in the outskirts of the city.

The increase in the business of Regina's electrical department was approximately 75 per cent. during 1912 and the first four months of 1913 have shown an increase of 86 per cent. over the same period a year ago.

A New Power House

To meet the demand of business increase, the city is undertaking the construction of a complete new power house located close to Wascana Lake where circulating water is

available. The plant will have a capacity of 12,000 kw. normal rating, and contracts have been let for equipment as follows:

Boilers—The Babcock-Wilcox Company for six 500 h.p. 200 lbs. pressure, 125 deg. F. superheat.

Stokers—The Sandford Riley Stoker Company for six 6-retort Riley underfeed stokers.

Economizers—The B. F. Sturtevant Company for six groups of economizers, each group having 160 twelve foot tubes.

Induced draught fans—The J. A. McTaggart Company for two 133,000 cu. ft. Sturtevant fans and stack.

Feed pumps—Peacock Bros. for two 12-in. x 9-in. x 24-in. Weir pumps.

Feed water heater—The Canada Foundry Company, for one Cochrane heater and meter; capacity 150,000 lbs. per hour.

Street railway generator—The Roper Clarke Company, for one 1200 kw. Peebles-Lacour motor converter with switchboard.

Street lighting—The Canadian Westinghouse Company for four 75-light metal flame arc lamp equipments 6.6 amps.

When the new power house, which is laid out with all modern equipment is completed, the old power house will be used for a water pumping station and street railway and street lighting sub-station. The cause of the changing of the location of steam generating equipment has been the insufficiency of the supply of circulating water for the condensors owing to the remarkable growth of the load.

The street lighting programme for 1913 will double the number of street lamps in use in this city.

In addition to this a scheme consisting of doubling the lighting in the business section is petitioned for, which will be done on the local improvement plan, and, when completed will make Regina second to none in Western Canada for street lighting.

Society of Electrical Development

The Society for Electrical Development recently formed for the object of bringing the value and variety of electrical appliances more prominently before the general public, have outlined a general plan of advertising and publicity which promises to have far-reaching results in popularizing the use of this modern necessity. It has been decided to hold the annual convention in Chicago on May 31st, so that the members of this society may also have a chance of attending the annual convention of the National Electric Light Association.

The general plans of the Society for Electrical Development, as recently published, are given herewith, from which the scope of the organization may be judged. It is understood that these plans have the approval of the National Electric Light Association, the National Electrical Supply Jobbers' Association, and the National Electrical Contractors' Association.

Advertising

A national advertising campaign in general magazines, trade and class papers, etc. This campaign to be of a broad educational nature designed to educate the consuming and non-consuming public to the many advantages of electricity for light, heat, power and other useful purposes, including special arguments for adequate wiring circuits, outlets, etc.

A comprehensive follow-up system in connection with the above so that each individual member will receive a copy or notification of every inquiry coming from his locality and the manufacturing members will receive direct copy or notification of every inquiry made relating to the apparatus which they manufacture.

Stimulating and assisting in the publication of educational literature of various kinds to architects, builders, other trades and the public, including publications of a similar character to those now being issued by the Commercial Section of the National Electric Light Association, Illuminating Engineering Society and by other outside agencies, and where it is not possible to stimulate the publication of booklets of this character, organization of this department to prepare those which seem necessary or advisable.

Booklets of an educational nature to be used as far as possible in answering direct inquiries coming from national advertising and other sources and also to be supplied in quantities at a minimum cost to members for local distribution through co-operation with the above agencies.

Collecting of material from central stations, manufacturers, advertising agencies, etc., and preparation of additional material if advisable, so that specific information can be furnished relative to advertising copy and cuts for newspaper advertising, booklets, folders, envelope stuffers, circular letters, etc., to assist members in planning and carrying out advertising campaigns. This can be accomplished at low cost by close co-operation with members, advertising agencies, etc.

Advising and arranging for and furnishing material for national publicity and advertising weeks (or months) on certain phases of electricity.

Accumulating and furnishing to members data regarding development and sales campaigns to increase the use of electric signs, improve and develop street lighting, power, heating, etc.

Maintaining of information bureau for statistics and data of various kinds relating to commercial subjects—merchandising, selling campaigns, advertising, etc.

Publicity

The accumulating and disseminating of data, photographs, etc., for use in newspapers, general magazines, trade and class papers, as well as to free lance writers, furnishing data, articles and stories of all character to all classes of publications including architectural, building, farm publications, women's magazines, etc., etc.

Furnishing articles and information to the trade press as well as to the bulletins of the National Electric Light Association, the Jovian Order, National Electrical Contractor, Illuminating Engineering Society, Efficiency Society, etc., etc.

Furnishing of a news service to members to be used locally in newspapers.

Arranging with newspapers through the country and with magazines, newspaper syndicates, trade press, special writers, etc., for stories, articles and information.

Furnishing of news material to co-operative newspaper pages where requested.

Preparing and disseminating of articles and information which will assist in the unification of water power laws, electrical ordinances, sign and wiring regulations and the like.

Preventing as far as possible the publication of untrue articles or stories tending to injure the business or mislead the public and to correct any misinformation published.

Field and General Effort

Co-operation with Jovians and other electrical societies and organizations as a national proposition and locally among the various branches and local leagues to obtain co-operation in the industry and in the carrying out of the Society's work.

Suggesting various ways and means for co-operation among the different electrical interests in the electrical and

allied industries and stimulating as far as possible more harmonious relations and wider co-operation among the various interests engaged and either by stimulating local endeavor or by carrying out work direct, assist in various lines of local development, etc., etc.

Suggesting ways and means of co-operation locally in the various cities with the Chambers of Commerce, Boards of Trade, etc., for the development of the electrical business and the development of cities.

Addresses by trained men before various electrical societies and before architectural, building trades and various other industries to increase co-operation and acquaint them with the greater value of electricity for light, heat, power and all other useful purposes.

Working nationally and locally for better co-operation with Underwriters Laboratories throughout the electrical business to improve conditions generally, a special committee to be appointed for this purpose.

Stimulating and assisting in organization of co-operative community advertising.

Arranging locally for equipping of various industrial plants for electricity to the fullest point of saturation.

Exchanging information regarding plants so equipped and arranging for publicity throughout the industry and to the public regarding such plants.

Assisting in plans for bureau for lectures and demonstrations in various cities.

Assisting general co-operative plans for moving picture exhibitions, exchanging of films, etc., perhaps in connection with traveling electrical show.

Assisting by suggestion in ways and means for developing day-load electricity on the farm, household appliances, power, etc.

Maritime Electrical Activity

The Fredericton Gas Company plan the installation of a 300 kw. high pressure condensing turbo-generator set with direct connected exciter. Tenders are in and contract will be awarded shortly. This company is also planning on extending their lines across the St. John River to connect up the towns of Gibson, St. Marys and Marysville. These towns are at present without an electric service. In connection with this work there is a draw-bridge to be crossed which on account of local conditions presents a rather difficult problem.

Amherst, N.S.

The Canada Electric Company have recently placed an order with the Can. Gen. Elec. Company for one 1000 kw. Curtis high pressure condensing steam turbo-generator set. This machine will be wound for 11,000 volts, 3-phase, 60 cycles and will be installed in their Chignecto power house. On account of the industrial activity in Amherst the power company's load has increased very rapidly. Lightning recently struck and set fire to their Amherst sub-station, doing considerable damage. Several of their linemen had a narrow escape while endeavoring to remove transformers from the burning building.

St. John, N.B.

The St. John Railway Company are making considerable extensions to their lines in order to connect up the new industries starting in the suburbs of St. John. To take care of their increased load orders have been placed for additional equipment, including one 2,000 kw. C. G. E. Curtis mixed pressure turbo-generator set, the generator being 3-phase, 60 cycle, 2200 volt. This company also recently placed an order for additional street lighting equipment, which included a fifty light constant current transformer and fifty a.c. series lamps. They are planning the installation of a motor generator set in the near future.

Dartmouth, N.S.

The Acadia Sugar Refinery Company, whose plant was recently totally destroyed by fire, are now re-building on a larger scale than before. The new refinery when completed will cost about two million dollars and will be electrically driven throughout. Three 750 Westinghouse turbo-generator sets will be installed. There will be about sixty motors used around the plant. The order for motors has not yet been placed. In connection with the power plant the company have erected one of the largest chimneys in Canada, the dimension being height 255 ft., diameter at bottom 21 ft., inside diameter at top 11 ft. John Starr & Company, has the contract for wiring the building which will be done in conduit. James Buchanen & Company, Liverpool, England, are the consulting engineers.

Campbellton, N.B.

The Corporation of Campbellton have recently placed an order with the Canadian General Electric Company for a 25 kw. series luminous magnetite equipment. This is a duplicate order of the one installed after their fire and includes, besides the rectifier and transformer, 25 series magnetite lamps with cutouts and arms. This town is operating a gas producer plant consisting of 2 Canada Foundry producers of 150 h.p. each, one 2 cylinder 180 h.p. Premier engine and one 4-cylinder 350 h.p. Premier engine. The electrical equipment includes 1-100 kw., 3-phase, 60 cycle, 2200 volt, belt driven generator with belted exciter and 1-200 kw., 3-phase, 60-cycle, 2200 volt unit. The switchboard comprises five panels with a complete equipment of instruments including a Tirrill regulator. The complete equipment was supplied by the Canada Foundry Company and Canada General Electric Company, and was installed by the town's superintendent, Mr. H. G. N. Farrer. Great claims are being made by the town regarding the high economy of this plant.

Halifax, N.S.

The Halifax Tramway Company had during the past month the only serious labour trouble since the starting of their tramway. This was a strike of the motormen, conductors and car barn employees. The company in anticipation of a strike imported some fifty substitutes from Montreal, and immediately after the men walked out they attempted to operate a service. After having a number of cars and the main office building badly smashed by strike sympathizers the service was discontinued and Halifax was without cars for five days. The men went back to work with an increase of 1½ cents per hour and signed a two-year contract along these lines.

Sydney Mines, N.S.

The Nova Scotia Steel & Coal Company are planning on a quantity of new developments in connection with both their mining blast furnace departments. This will require considerable additional electric equipment. They recently put in operation at this plant a 1000 kw. high pressure turbo-generator set consisting of a Fraser, Chalmers turbine and a Siemens a.c. 3-phase, 60-cycle, 2200 volt generator. Orders were recently placed with the Siemens Company for a 125 h.p. a.c. hoisting outfit, using the Ward Lenord System. Also an order with the Canadian General Electric Company for 1-300 kw. synchronous motor-generator set, the generator to furnish 250 volt direct current for mining machinery. This order includes sub-station equipment, transformers being 150 kw. each, 11,000 to 2,200 volt.

Sydney, N.S.

The Cape Breton Electric Company are discontinuing the operation of their steam driven plant at Glace Bay and in place of same are installing at Reserve Junction a 300 kw.

synchronous motor-generator set for operating the Sydney and Glace Bay Electric Railway. A 22,000 volt transmission line is being constructed from their Sydney power house to Reserve Junction. When the motor generator set is installed the steam plant will be removed to their North Sydney sub-station. The Canadian General Electric Company have the contract for motor-generator set and sub-station equipment also for new switchboard at Sydney power house.

New Glasgow, N.S.

The Pictou County Electric Company have recently added to their rolling stock three double truck, four motor, semi-convertible cars to take care of increased business due partly to the new car works at Trenton, and are now operating a fifteen-minute service between Trenton and Stellarton. This company has shown a remarkable growth during the past three years and are supplying the towns of Westville, Stellarton, New Glasgow and Trenton with a splendid tramway, light and power service. In order to meet the increased load, orders have been placed with the Canadian General Electric Company for 1-300 kw., 600 volt, 300 r.p.m. d.c. railway generator for direct connection to a Robb vertical compound engine; also 1-150 kv.a., 60-cycle, 3-phase, 2200 volt, 450 r.p.m. generator for direct connection to a Robb vertical compound engine. This equipment will be installed in the company's Stellarton power house.

Value of an Electric Vehicle Load

With the increasing use of electric vehicles for both pleasure and commercial purposes central stations are paying more attention to battery charging as a primary source of revenue rather than a secondary one, and the wisdom of this practice is revealed by the fact that one electric light company last year earned $150,000 net from this source alone. The original practice of viewing battery charging as an excellent "side line" to assist in reducing overhead expenses, is rapidly giving way to the more logical view that it may with profit be made a specialty, in charge of qualified experts ready and willing throughout the whole twenty-four hours, instead of during only that time when the central station meters do not indicate the peak load.

The nation-wide rate of increase in electric vehicles last year was over 200 per cent. In large cities the growth has indeed been rapid: for instance, in Boston the rate of increase in the last two years was 134 per cent. In New York the number of electric vehicles in service grew 45 per cent. between the summers of 1911 and 1912, and in the last two years electric trucking has increased 400 per cent. in Chicago.

Since the Public Service Corporation of New Jersey entered the campaign two years ago, the number of electric vehicles in its territory has risen from 139 to 440, and the average cost of charging service has been reduced from slightly over 4 cents to about 3.5 cents per kw.hr. About 80 per cent. of the commercial electric vehicles are used east of the Alleghanies, the heaviest demand for pleasure cars coming from the middle west. On the streets of Chicago there are over 3,500 electric pleasure cars and Denver has a greater percentage of pleasure cars per capita than any other city in the country.

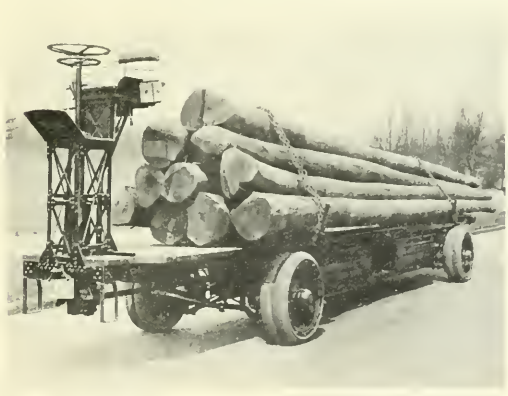
In 1906 Peter Doelger, a prominent New York brewer, had 120 horses, a stable, 200 feet street frontage by 100 feet deep, no less than three wagon yards, a blacksmith shop, and other horse delivery equipment. In 1909 he purchased his first electric truck and later in the same year six more. In 1910 he ordered eighteen more electric trucks. In 1911 he was operating thirty, and these electric trucks are what save him, on the testimony of his own superintendent, $25,000 a year. By July, 1913, this brewer will be operating fifty-two electric trucks and no horses whatever, as they have all been sold. Half of his former stable has been torn down, and a handsome building three storeys high has been erected on the space thus secured, this building being devoted to a bottling plant and shipping room. On the ground formerly devoted to one of his wagon yards he has built a fine garage, 85 feet by 100 feet, two storeys high, with a capacity of forty-eight trucks, or twenty-four to each floor, and he will shortly add two more storeys, thus enabling him to accommodate ninety-six electric trucks.

In addition to the missionary work which central stations all over the country have done to advance the popularity of the electric vehicle, both pleasure and commercial, and to overcome the prejudice that wrong information had given rise to, central stations themselves are finding that the electric vehicle is highly suitable to utilize for their own purpose.

The Philadelphia Electric Company, for instance, is using an electric truck in its distribution of poles. The truck, which is of six tons' capacity and weighs, when unloaded, about 12,000 pounds, has a decided advertising value. The name of the company is conspicuously displayed, as well as the company's motto, "If it is not Electric, it is not Modern." Innumerable questions have been asked regarding the operation of the truck and it has done a great deal to attract the general attention to the use of electric vehicles.

The Commonwealth Edison Company employ seventy-two electric vehicles in every branch of their service and the results obtained have been so satisfactory that this company is contemplating placing in service thirty more, some of which have been ordered already.

The Rochester New York Railway & Light Company has during the past four years motorized its service until it



Storage battery truck distributing lighting poles.

now includes sixty-one electric vehicles. The average mileage of all machines, which are of varying tonnage, is not far from twenty-five miles.

Another central station that has been active in the promoting of the use of electric vehicles is the Consolidated Gas Electric Light & Power Company of Baltimore, Md. This company employs twenty-one electrics and has three more ordered, which will shortly be delivered. Two years ago the company had no electric vehicles and now, in addition to its own equipment, it maintains a garage with a capacity of forty-eight machines.

These definite instances of central station progress in the popularizing of electric vehicles are only a few chosen

from many that could be cited. They are, however, sufficient to prove that the central stations throughout the United States are thoroughly awake to the possibilities of the "Electric" as a source of revenue, and are putting their shoulders to the wheel gladly in an endeavor to cause the "Electric" to come into its own, as the logical vehicle for city and suburban use.

The Electric Vehicle Association of America is an organization of the central stations and interests the electric vehicle manufacturers and the paper and accessory manufacturers. It conducted a most successful campaign last year in over fifty magazines and trade papers. At the present time the association is soliciting funds preparatory to its second years' campaign, and the number of increased renewals received from its members is eloquent testimony of the success of its first year's publicity.

The situation in Canada, while not so advanced as that in the United States, is showing marked progress in favor of the operation of electric vehicles. In Montreal as against three electric vehicles of all sorts a year ago there are now ten trucks and eighteen pleasure vehicles at the last report. Of the trucks the Montreal Light, Heat & Power Company operate one G. V. 750 lb. capacity; one Lansdowne, 3½ ton; one General Motors, 3½ ton; one General Motors, 2 ton, and one Bailie runabout. The Ogilvie Flour Mills operate a 5-ton Lansdowne; the Toilet Laundry a 2-ton Lansdowne; the Canadian Express Company, two 2-ton and one 1-ton G. V., and the Eugene Phillips Electrical Works one 1250 G. V. truck.

In Toronto the O'Keefe Brewing Company are now using four electric trucks, the Toronto Electric Light Company 2, the Canadian Express Company 3, Robt. Simpson Company 1, The Heintzman Piano Company 1, The Murray-Kay Company 1, and the Langmuir Manufacturing Co. 1. Figures of the number of electric pleasure vehicles are not available but it is probably somewhere in the neighborhood of fifty.

The city of Calgary early in the year placed an order for seven electric trucks with the General Motor Company of Detroit. These are three 5-ton trucks, two 3-ton, and two 1-ton.

Electric Vehicles in B.C.

The number of electric vehicles at present in operation in British Columbia is 118, of this number 100 are pleasure vehicles and the remaining 18 are commercial trucks. Until the present year the sale of electric vehicles in this province had been pushed by agents who handle both gasoline and electric cars. A few months ago the British Columbia Electric Railway Company was awarded an agency for commercial cars, and immediately entered upon a vigorous selling campaign in Vancouver. At the present time the company, besides owning one business car, operates a fleet of five electric trucks in its light and power department.

The first electric truck was sold in Vancouver a little over seven years ago, and despite hard usage, it is to day still in active service. A two-ton truck purchased last year by the Brackman-Ker Milling Company was used in Victoria for a year and gave such satisfaction that this year the company placed an order for one 5-ton truck and one 2-ton truck.

A record was recently kept on the operation of the company's 5-ton truck for 27 days, and it was found that the truck averaged 25 miles per day, the current consumed during this period amounting to 1489 kw. hours.

The B.C. Electric Company is now erecting a garage in Vancouver for commercial trucks, and the rates being offered for storage, etc., are as hereunder:

Capacity of Truck	Garage Charges per month
750 lbs.	$45.00
1,000 lbs.	45.00
2,000 lbs.	55.00
4,000 lbs.	60.00
7,000 lbs.	65.00
10,000 lbs.	70.00

These charges cover storage of car, current as required and charging of batteries, daily washing and oiling, and minor adjustments.

As far as pleasure vehicles are concerned, the private garages take care of this branch of the business, the rates quoted being from $30.00 to $35.00 per month which includes the services mentioned above, in addition to calling for and delivery of cars.

Considerable success is reported by the B. C. Electric Railway Company in its commercial business, the sales put through up till the present being one 2-ton truck to a wholesale grocery house, one 2-ton truck to a hardware merchant, one 1-ton truck to another hardware firm, and one 1-ton truck for use as a hotel bus.

Hamilton as an Electrical Centre

The City of Hamilton has during the past two years made some very important and far-reaching moves. The passing, on July 25th, 1911, of the by-law to raise $505,000 by the ratepayers, placed Hamilton among the Union of Municipalities to use hydro-electric power developed at Niagara Falls and distributed by the Hydro-electric Power Commission of Ontario. This has not only meant a competitive power and light supply for the citizens of Hamilton, but added another large Canadian city to the already extensive list adopting municipal ownership of public utilities. The rate situation is materially improved, whereas cheap power for large consumers was already a prominent feature of Hamilton's industrial progress, the advent of hydro-electric has further lowered this cost and has placed at the disposal of manufacturers and merchants a further power supply both continuous and reliable. Power and light users are probably enjoying the lowest rates of any city on the continent and as the quantity of power purchased by the city governs the price there undoubtedly will be further reductions. Hamilton's geographical position is unsurpassed by any municipality using hydro. Being forty miles nearer the source of supply than any other city of importance demanding a large amount of power the cost is reduced to the city and necessarily to the consumer.

The plans of the Hamilton Hydro-electric Department cover the installation of one main station, centrally located, one west end sub-station and an east end sub-station which is now in operation. The available capacity of these stations will be 8,000 h.p. with a designed capacity of 16,000 h.p. The proposed street lighting system, which will be in operation on July 1st, 1914, is designed for about 1,000 kw. capacity, using 400 ornamental luminous arc lamps constituting a Great White Way on the principal streets of the city, where the purpose of illumination is to create a brilliant effect with the consequent exhilaration which accompanies this condition. The residential districts will be beautifully lighted by 7,000 bracket lights mounted on concrete poles carrying secondary wires.

Throughout the central portion of the city, there will be no poles on the streets, with the exception of those used for trolley wire suspension. This underground system has been designed and provided for in the estimates and will cover seven miles of streets accommodating the C. P. R. and G. N. W. telegraph companies as well as the Hydro and Cataract light, power and traction wires.

Work is progressing very rapidly on the Hydro-electric distributing system. Large sections of the city are already

provided with service and by the end of the year hydro power will be available to all residents and power consumers.

The Dominion Power and Transmission Company have made some large extensions during the year. Two large turbine units have been provided for at their Decew Falls generating plant, while the expansion of the Steel Company of Canada at their Hamilton plant adds a very large consumer. An additional transmission line from Decew Falls to Hamilton is also among the proposed extensions. This company is contemplating building a million-dollar steam auxiliary plant. The presence of needle ice at Decew Falls in the winter, resulting in a temporary shutting down of the generators, has induced the company to guard against similar occurrences by making its steam auxiliary capable of producing 30,000 horse-power—sufficient to meet the demands of to-day.

The establishment in Hamilton of the Standard Underground Cable Company of Canada, the Boston Insulated Wire & Cable Company of Canada and the Canadian Porcelain Company places Hamilton with her already large electrical industries, in the first place as an electrical manufacturing centre.

Canadian Crocker-Wheeler Company

The Canadian Crocker-Wheeler Company, Limited, St. Catharines, announce that they have acquired the rights for, and are now supplying in Canada and Newfoundland, the manufactures of the well known continental firm of engineers, Messrs. Brown, Boveri & Company whose pioneer work in the development of both electrical and steam turbine machinery has entitled them to place in the front rank of these industries. The firm of Brown & Boveri was founded in 1891 at Baden, Switzerland. Their products are well known in almost every phase of the electric industry including generators, motors, steam turbines, transformers and switch gears, etc. Within the last few years this firm have placed on the market two lines of particular interest, namely, the phase compensator or advancer and a special type of automatic voltage regulator. They have also done their share in the development of electric railway equipment, and are now building six 2,500 h.p. single phase locomotives for the Lotschberg tunnel service.

Outremont Undergound

Mr. G. M. Gest, of Montreal and New York, has been awarded the tender for the construction of a system of underground conduits for the town of Outremont, P.Q. A twin system will be built, one set being used by the town for the distribution of light and power in the future, and the other set by the Bell Telephone Company. The town originally accepted the tender of Dietrich, Limited, Montreal, the price being $81,000, as against $98,000 asked for by Mr. Gest. This decision was against the recommendation of Dr. L. A. Herdt, the consulting engineer, and of the Bell Telephone Company, who were strongly in favor of Mr. Gest's tender on account of the wide experience Mr. Gest has had in this class of work. On the understanding that Mr. Gest be given the work the Bell Telephone Company agreed to pay 50 per cent. of the cost of $98,000 and 47 per cent. of the extras and costs of re-paving, in addition to the sum of $2,000 to cover engineering expenses and inspections. This was in lieu of 47 per cent. of the total contract originally agreed upon by the company. The Council in accepting the tender of Dietrich, Limited, inserted some stringent provisions into the contract, and Dietrich, Limited, after consideration, withdrew their tender, upon which the council accepted that of Mr. Gest. Mr. Gest has undertaken to construct the conduits in 250 good working days. Altogether, five tenders were sent in for the work.

Saskatoon Developments

Since the first of January, 1913, 249 new light customers and 51 new power companies have been connected up. The total number of consumers to date is 3,979 light and 284 power, making a grand total of 4,263. About 160 new arcs are to be erected in the outlying portions of the city and about 60 5-light ornamental standards, with tungsten lamps, are being erected down town. Three 50 lamp, 2400 volt series d.c. rectifiers, C. G. E. type., are being added.

A by-law was recently passed allowing $150,000 for power house extensions. In this is included a 3,000 kw. turbine which it is hoped to have ready for operation before the end of the present year.

The street railway which was started up at the beginning of the year and which is now under the direct supervision of the city electrical engineer, Mr. Edward Hanson, is now in good working order. The system started out with twelve single truck cars, but these have proven inadequate. By-laws to the amount of $200,000 have been passed for street railway extensions and provision has been made in these for twelve double truck cars. 10,000 feet of the present system is to be double tracked this year, and about 3½ miles of single track will be laid down. This does not include an extension to the neighboring town of Sutherland about 3½ miles out, which is being built privately and handed over to the city, ready for operation.

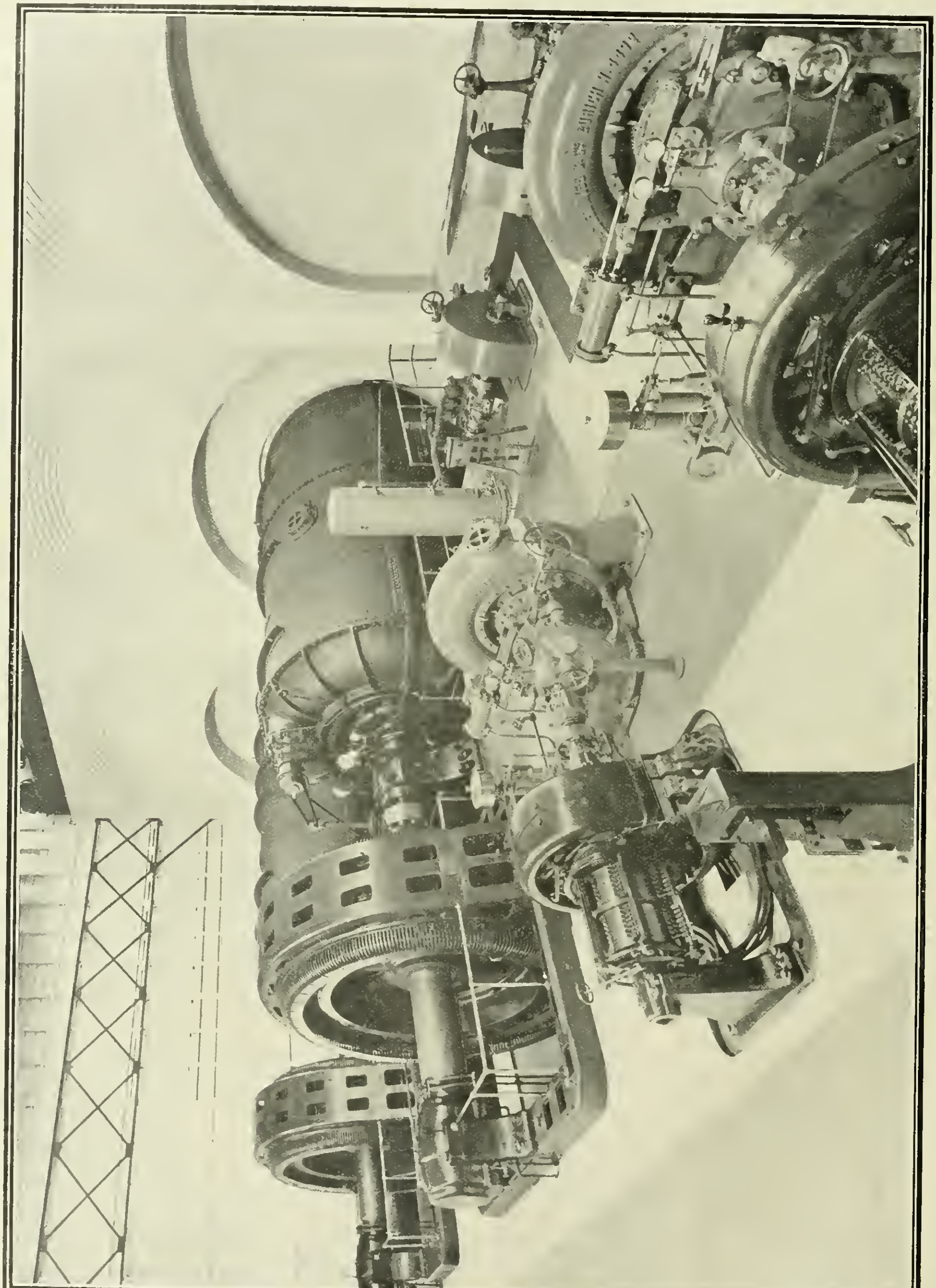
The Halifax Power Company

The Halifax Power Company are planning to develop two sites on the Indian River, 18 miles west of Halifax. The upper station will include two units of 1200 kv.a. each. One operating on 90 ft. head from the Indian River water-shed and the other operating on 160 ft. head from the North-East River water-shed; the latter water is carried over to the Indian River by means of a long pipe line. The lower station will include two units of 1200 kv.a. operating on 90 ft. head; in this station the step-up transformers and high-tension gear will be placed.

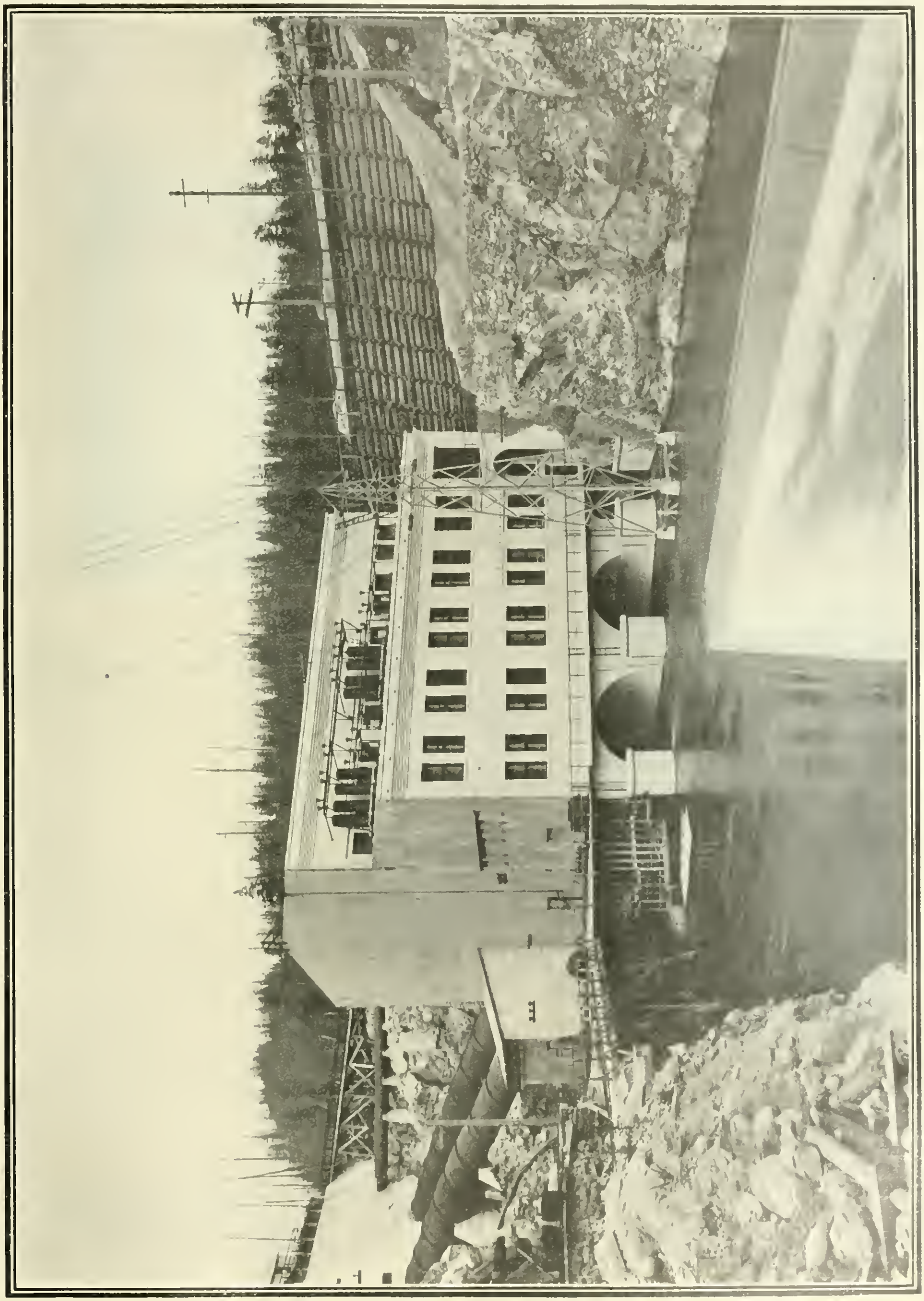
These developments will render 5600 h.p. available in Halifax, which will be carried over a duplicate transmission line by two separate routes. Transmission will be at 33,000 volts. It is the intention of the company to sell this power for lighting and industrial requirements in Halifax. Plans are well under way for the upper development, one transmission line and receiving station, and it is expected that this portion of the work will be proceeded with immediately. Messrs. C. H. & P. H. Mitchell, consulting and supervising engineers, Toronto, have charge of this development.

The Western Canada Power Company

We reproduce herewith some very fine cuts of the generating equipment of the Western Canada Power Company. The power house capacity is now being doubled, which will raise it to 50,000 h.p. A little lower down the river there is a second fall capable of developing another 50,000 h.p. A recent statement of the president, Mr. C. H. Cahan, is to the effect that the demand on this power house will, according to present indications, be approximately 100,000 h.p. by the year 1920. The president also stated that this total capacity of 100,000 h.p. would be made with an actual bonded indebtedness of less than $130 per h.p. including dams, power houses, main transmission lines and power distributing systems. The work and equipment throughout is acknowledged as of the best and entirely in accord with the most approved engineering practice of the present day.



View of interior of power house, Stave Falls—Showing two 13,000 h.p. units, with exciters—Western Canada Power Company



Power House, Stave River—Western Canada Power Co.—The capacity of this power house is being doubled by extending the building to the bank of the river on the left of the picture

Personals

Mr. Henry C. Bentz has resigned as district sales manager of the Northern Electric & Manufacturing Company, Limited, Winnipeg.

Mr. A. L. Woolf, of Winnipeg, western manager for the Canadian Tungsten Lamp Company, recently made an eastern trip, visiting Toronto, Hamilton and Montreal.

Mr. C. C. Clark, of the firm of Kilmer, Pullen & Burnham, Toronto, was married on May 21st, in Montreal, his bride having arrived the day before from England.

Mr. E. A. Schofield, a member of the firm of Jones & Glassco, St. Nicholas Building, Montreal, was married on May 31st to Miss Leonard, daughter of Mr. F. E. Leonard, of the firm of E. Leonard & Sons, Limited, London, Ont. The marriage was celebrated at the Memorial Church, London.

Mr. H. H. Couzens

The newly appointed manager of the Toronto Hydro-electric System, Mr. H. H. Couzens reached the city during the latter week in May, and is now occupying his time in getting into close touch with the various phases of the work before assuming actual management, which he will probably do about the first of July. Mr. Couzens brings to his work the admirable combination of a broad experience at an early age, for though only 35 years old, he already has carried through as varied a programme as falls to the lot of most at a much more advanced stage in life. Among the positions of responsibility which have been held by Mr. Couzens

Mr. H. H. Couzens

may be mentioned the following: from 1896, when only 19 years of age, he was assistant engineer for the Taunton Corporation and during the year 1897-98 was acting chief assistant. From 1898-99 he was generating station assistant to the Bristol corporation; from 1899-01 mains engineer, Bristol corporation; 1901-09 deputy electrical engineer, Bristol corporation. During the years 1909-12 he was engineer and manager, Westham corporation, and from 1912 up to the time of his resignation to accept the Toronto position he was general manager and engineer of the Hampstead corporation. Mr. Couzens, early in life served a pupilage in mechanical and electrical engineering at Messrs. Allan & Sons, and later in the Taunton Corporation Electricity Department.

Mr. Lawford Grant

As intimated in our last issue, Mr. Lawford Grant, president and managing director of the Canadian British Insulated Company has resigned that position to associate himself in an important capacity with the Eugene F. Phillips Electric Company of Montreal. For several years Mr. Grant has been a prominent figure in Canadian electrical trade circles and the following items in connection with his early life and training will be of interest. He was born in

Mr. Lawford Grant

1878 and educated at Winchester House, Clifton, Eng. Leaving there, he began his career as an engineer with Mr. Arthur Powell, M.I.C.E., of Bristol, to whom he was articled, but in 1901 Mr. Grant joined the engineering staff of the British Insulated and Helsby Cables, Limited, for whom he carried out many large contracts in various cities of the British Isles during the next few years. In 1905 he was placed in charge of a large contract in the Mediterranean in connection with the electrification of the naval dock yard at Malta, which occupied practically two years. Immediately afterwards his company decided to open a Canadian office and Mr. Grant was appointed general manager for the Dominion. The development of the business has been so marked that it has since been found necessary to organize a Canadian company under the name of the Canadian British Insulated Company, Limited, and since its formation in 1909 Mr. Grant has filled, with exceptional efficiency, the position of president and general manager. Mr. Grant is also well known throughout Canada as the honorary secretary and treasurer for the Dominion of the Institution of Electrical Engineers. He is a member of this society, an associate member of the Canadian Society of Civil Engineers, and an associate of the American Institute of Electrical Engineers. Mr. Grant is also a director of E. M. Sellon & Company, brokerage house, Montreal.

Hydro Development on Severn River

The Hydro-electric Power Commission of Ontario have called for tenders for the construction of a concrete dam and a reinforced concrete power-house at Wasdell's Falls on the Severn River. At this point about 1200 h.p. can be developed at peak load and two 600 h.p. generators will be installed. This plant will serve the Cannington, Beaverton, Sunderland district with power and light.

The Growing Use of Electricity on Farms

No longer a theory—Practical applications in the Trent Valley Canal—Initial expenditures are small, operating costs reasonable

Notwithstanding the phenomenal growth which has characterized manufacturing industries and transportation systems in Canada in recent years, the prosperity of our Dominion as a whole, still is, and must remain fundamentally dependent for its success on our agricultural developments. The Dominion census of 1911 tells of an ever-increasing population of our cities, and, with the exception of the Western provinces, the gradual decrease of the rural populations. This is all the more significant from the fact that the demand for farm products has enormously increased. As a result the farmer is hampered to a very great extent for labor, both on account of the greater attractions and opportunities of the larger centres and on account of the greater demands for supplies made upon him.

It would appear, therefore, that the most modern methods available are not only justifiable, but are an absolute necessity both from an economical point of view as well as from the standpoint of being properly equipped to meet the ever-increasing demand for farm products.

That this has been realized by the farmer to some extent for years past is evidenced by his eagerness to adopt improved machinery, labor-saving devices, and approved methods of cultivation. The introduction of the threshing machine, the self-binder, the latest type of cultivators, mowers, fertilizers, hay tedders, loaders, etc., are recognized as profitable investments and have been generally adopted because successful farming would be impossible without their use. The introduction of the telephone as a method of rapid and general communication was at first considered a luxury, but to-day its use is becoming general, and its value as a necessary auxiliary of modern farm business is best shown by the fact that these instruments, when once installed, are never removed. Through certain sections of the country practically every home has its telephone, and those sections not so served as yet, are being rapidly covered.

Motors Supplant Windmills

The adoption of the windmill by the farmers, as a method of developing energy was one of the first evidences that motive power could be utilized to advantage in many ways around the farm buildings. This one item alone has done much to improve conditions on the farm. At the present time, however, as a result of the intermittent service delivered by this type of prime mover and the increasing demand for power, this class of installation is unable to satisfy the needs of the present day farmer. The gasoline engine, a later introduction, has improved the service, but it possesses many disadvantages in that it is not instantly available, that it will only operate at best a few hours a day, that it is becoming always more expensive to operate, and that it is associated with a considerable amount of fire hazard.

Electricity, on the other hand, is capable of meeting the needs of farm life and of solving the problems of the farmer more completely and at a much more moderate expense than was deemed possible a half dozen years ago. It is instantly available; it is fireproof; it is exceedingly reasonable in first cost and up-keep; operating costs are low; it supplies light in unlimited quantities to every building on the farm and in every corner of every building; it is flexible as a power source in that it is adaptable to a dozen different classes of work around the barns and home.

For some years machinists and electrical manufacturers have been concentrating their efforts with a view to adapting the machine tool and the electric motor to each other, either by belt or direct drive and the developments in this important field of industry may at last be regarded as fairly complete—for there is practically no class of business in to which electricity has not made its way as the source of mechanical power.

Electric Lighting

It is now generally recognized that electricity furnishes the safest, cleanest, most effective, and by far the most convenient system of artificial lighting. It is especially valuable for use in farm houses, stables and barns where there is always danger of fire if oil, acetylene or gas lamps are used. Electric lamps require no matches, burn without flame and are entirely safe, there being no danger of fire even if the lamps are broken. From the labor-saving point of view also, it is worthy of note that their use eliminates all the work of filling, cleaning, and trimming oil lamps and the danger of explosion inherent in the use of gasoline lamps. Then, electric lights are the acme of convenience. By the simple turning of a switch light is produced. The switches may be arranged in many different ways so that lamps in any room may be controlled from any point. There is practically no limit to the convenience of control, it being only a matter of a little added expenditure. Electric lamps do not blow out with a draft of air.

Other Uses in the Home

The drudgery inseparably associated with house work on the farm may further be relieved to a very large extent by the introduction of a number of labor-saving devices which the use of electric current renders available. Probably the most practical and most generally used of these devices is the electric iron, by which it is possible at a small expense to do in one hour what, with the old fashioned iron takes two, and to do it much better and with much less expenditure of energy. Among the other safe, sanitary and entirely practicable household equipments may be mentioned a number of electric heating and cooking devices which today are so well constructed as to be practically indestructible and to be free from danger to the operator. These include toasters, tea kettles, soup kettles, coffee percolators, tea urns, chafing dishes, cooking ovens, egg boilers, frying pans, electric stoves and ranges, heating pads, foot warmers, luminous radiators, etc., etc. This apparatus is all practical; the initial cost is reasonable and the operating charges are smaller than generally supposed.

In addition to the above household equipments there are a number of others for which small motors are required. In every case from 1/6 to ½ h.p. is ample. These equipments include coffee grinders, meal grinders, ice cream freezers, motor operated sewing machines, vacuum cleaners, washing machines, wringers, etc. The number of devices to which these small motors are applicable is practically unlimited and their low cost places them within the reach of every one who may be able to find use for them.

Electricity at the Barns and Stables

Nor is electricity any more adaptable to the house than to the stables and barns. Until recent years farmers have had to content themselves with methods for development of power such as the windmill, gasoline engine, tread power, etc., the only use to which electricity has been put in benefitting him being in telephone and telegraph lines. Within the last two or three years, however, developments in the

art of distribution and application of electricity have made it possible to meet the requirements of the rural population almost with the same efficiency as the city manufacturer is served. The stables and barns stand to the farmer in much the same relation that the factory does to the city manufacturer, and no manufacturer nowadays considers himself properly equipped for business unless his factory contains all the modern advantages of electric lighting and electric drive. It means a greater initial expenditure to the manufacturer, but experience has taught him that it is money well spent. The same argument is applicable to the farmer. Those who have already installed electric equipment in their buildings are unanimous in their evidence that it is money well invested from every point of view.

As already pointed out the manufacturer and the engineer have been working together to produce an equipment by which they can supply rural districts with light and power at reasonable rates. Improvements in distribution in lighting units and in small motors to give an entirely satisfactory service are the result. It now remains for the distributor to co-operate with the farmer in the installation of this apparatus and that the importance of the situation is being grasped by many municipalities is shown by the number of rural lines being run at the present time at many different points throughout Canada. The Hydro-electric Power Commission of Ontario has done much to arouse interest in this subject, but there are a number of private companies who have been active in carrying out the actual work of supply. One of these is the Electric Power Company, with its numerous subsidiaries operating throughout Central Ontario and more particularly in the Trent Valley district. For years the distribution of electric current along every cross road of this area has been the dream of the Electric Power Company and already much work has been done. This is evidenced by the following list of distribution lines that have been run in the last two or three years, from which light and power is now being supplied to the farmers and others living in these vicinities. We believe, indeed, that this company has done more towards serving rural communities than any other central station in America.

Actual Installations

From Campbellford to Hoard's Station, a distance of twelve miles, a distribution line has been run; from Napanee to Newburg and Cambden East, 10 miles; from Belleville west on the Trent Road, 2 miles; from Brighton to Smithfield, 4 miles; two extensions west from Cobourg between 3 and 4 miles altogether; from Newcastle to Orono, 5 miles; from Oshawa to Harmony to Cedardale, 7 miles; from Oshawa to Whitby, 4 miles; and many other extensions are planned. The total amount of power taken from these lines varies from a minimum of 15 h.p. up to 75 h.p. No service less than 1 h.p. is installed and the average farmer with up to 200 acres of land dequires from 3 to 5 h.p. It is considered by the company that a load of 2 h.p. to the mile is sufficient inducement for the installation of a line and equipment.

The particular class of work to be performed by the motors installed do, of course, regulate their size, but experience in this district has shown that practically every operation can be performed by a 3 h.p. motor. This would do the milking and pumping, operate the separator, pulp the roots, turn the fanning mill and drive a small circular saw. For grinding, however, the mills at present on the market require about a 5 h.p. and this size of motor is also required for wood cutting. Indeed, aside from these two operations a 2 h.p. motor will be found very satisfactory and this size is being installed by most 100 acre farmers.

The motors are not in general placed on a solid foundation, but are mounted on a truck or more often on a wooden frame work provided with handles so that it may be carried from place to place. One motor is therefore capable of being used to operate all the different machines. This plan has been found to work out well.

With respect to lighting, this company allows its customers the privilege of installing the equivalent of ten 16-candle power carbon lamps for every h.p. contracted for, so that the 100 acre farmer who contracts for a 2 h.p. motor to use in his barns and stables is free to install twenty 16-candle power carbon lamps, or, if he chooses, twenty 40-watt tungsten lamps from which he gets about 2½ times more light.. This has proven ample, as ten lights in the average farm home and ten around the other buildings will generally be found sufficient to meet the requirements.

The Electric Power Company have done much both by reasonable rates and by their fair and helpful treatment of their customers, to make the use of electric power on the farms in the Trent Valley district general and popular. Every assistance has been given in the purchase and installation of the equipment. No unnecessary frills have been introduced and the policy has been followed at all times of recommending a farmer to take just as much power as it seemed necessary he should have. As in other business transactions the case has often arisen where a farmer could have been induced to install a 5 h.p. motor where a 3 h.p. would do the work, but this policy has been most carefully avoided and the result is that the farmers who have had dealings with this company continue to have confidence that their advice is always given in the interests of the customer. In this way a friendly feeling of mutual benefit has been introduced which it would be well for all operating companies to develop. The farmer as a type, is naturally suspicious of the salesman, but if his confidence is once won he becomes a most excellent advertisement for the further extension of this class of business.

The Rates

The rates given by the Electric Power Company would appear to place electricity within the reach of every farmer who may be fortunate enough to reside in the vicinity of one of their distribution lines. No meters are used, it being taken for granted that the customer will not utilize more than the amount for which he contracts, say one h.p., 2 h.p., 3 h.p. or, as the case may be. For example, if a farmer signs a contract for 2 h.p. he is at liberty to use this amount twenty-four hours of the day, every day of the year, but he is not expected to use more than this amount at any time of the twenty-four hours. That he could easily break this agreement if he were so disposed, is seen by the fact that this customer is allowed to install 2 h.p. in motors and practically the equivalent of 2 h.p. in lighting, so that he is really able to take 4 h.p. off the company's lines. The experience has been, however, that the farmers respect their moral obligations and indeed this is only what anyone would expect from this class of customer.

The rates charged by the Electric Power Company, are $35 per year if only one h.p. is taken; $60 a year for 2 h.p.; $75 a year for 3 h.p., and $25 per h.p. per year for all above 3 h.p. This means, for example, that on a 100 acre farm where an agreement has been signed for 2 h.p. that all the various machines may be driven for one year and the barns and house may be lighted during the same time for an expenditure of $60. This is certainly an exceedingly reasonable amount when it is considered that it not only takes the place of other expenditures, but that it makes it possible to do much more work in the same time, do it better, and further, make it possible to have fewer employees who are often incompetent, generally not congenial, and at best have to be supplied with board and lodging.

The above rates include also the privilege of a number of farmers combining to use their maximum of power in any way. For example, two adjacent farmers who are each con-

tracting for 3 h.p. may purchase a 6 h.p. motor and utilize it at one barn or the other, the only condition being that no other power must be used while this motor is in operation. Or, a number of farmers, say five or six, may club together and buy a 15 or 18 h.p. motor, which will be sufficient to operate a threshing machine.

Exceedingly reasonable rates have been secured by the company for the installation work. It has been found that a 1 h.p. installation including motor, the necessary wiring for the lighting of the house and barns, and the lamps, can be kept within the sum of $110; a 2 h.p. equipment complete $175; and a 3 h.p. equipment $225. For larger installations the expense is only slightly greater. It will be seen, therefore, that the hundred acre farmer can install the necessary equipment for $175 and can operate the same 24 hours of the day every day of the year for an additional $60.

When we consider the amount of money the average farmer spends on implements which are used only a few days of the year, the installation of an electrical equipment such as has been described above, may well appeal to him as a good business proposition quite aside from the luxurious consideration associated with it. A binder costs him $140 and is used five or six days in the whole year. The mowing machine, etc., while less expensive, also operates only very short periods, and yet the progressive farmer knows that his work could not be carried on satisfactorily without these things. A few years ago all of these were considered luxuries, and it is safe to predict that within a very short time electric lighting and electric drive of many of the machines used around the farm buildings will be considered as much a necessity and economy as the self binder is now known to be.

As exemplifying the way the system is working out in actual practice in the Trent Valley district, it may be said that well over fifty farmers are at present reaping the benefits of this company's distribution system. The majority of the farmers in this district own from 100 to 300 acres, the average perhaps being about 200 acres. As an example, we may cite the case of Mr. Alex. Hume, the owner of a fine 200 acre farm who is just completing the installation of 5 h.p. Mr. Hume's house is electric lighted. It is supplied by water through a modern pressure system operated by a ½ h.p. motor. A 5 h.p. motor will do his milking, separating, saw his wood, cut straw, grind grain, etc. Another typical farmer is Mr. Thomas Walker, owning 400 acres and carrying on an extensive dairy business. A 4 h.p. motor has been found satisfactory for his needs, including the operation of the milking machine and the separator. Mr. G. V. Taylor, the owner of 200 acres uses 3 h.p. with which, among other needs, he drives his fanning mill. Thomas Stewart & Sons use a 5 h.p. motor on a 200 acre farm, as does also Jas. Stewart on a farm of the same size.

The Electric Power Company distribute their energy by a two-wire single phase line for the most part at 2400 volts. One of the lines, the longest, carries 6600 and one of the others 4400 volts. In general, each customer is fed from his own transformer which is placed as nearly as possible at the centre of the power distribution system of this particular customer. The company calculates that they can do business on a paying basis if 8 h.p. to the mile is secured.

Relative Merits of Distributing Systems

By Mr. F. T. Stocking

Since the beginning of three-phase alternating distribution little change has been made in distribution systems. It was early found that appartus could be made and lines erected to carry 2000 volts at a cost little in excess of that for lower voltages since the insulation on both apparatus and lines for this voltage was little more than that determined by mechanical considerations. Furthermore, work may be done on these lines while alive with comparatively slight precautions. Higher potentials have been advocated to reduce line losses and the enormous outlay on conductors, but in most instances it has been found advisable to use the 2000 or 2300 volt apparatus for distribution and to put in sufficient distributing stations to keep the cost of lines to a reasonable amount. The principal advance therefore has been in so arranging the standard 2300 volt apparatus as to reduce the cost of distribution to a minimum. For this purpose the 4-wire Y connected system with grounded neutral has been employed and its use is steadily increasing. By this method the transmission voltage is raised from 2300 to about 4000 volts, the potential between any wire and ground being kept at 2300 volts which voltage not infrequently obtained with the delta connected system.

From the victor diagram of a delta connection shown in Fig. 1 it is obvious that 2300 volts will be the potential between any two conductors. In Fig 2 solving the triangle A, B, C. the potential between A and B is $2300\sqrt{3}$ = about 4000 volts which will be the potential between line wires, the potential between each of these and neutral or ground being 2300 volts.

For the same per cent. voltage drop or per cent. power loss the carrying capacity of a given conductor varies as the square of the voltage. The carrying capacity of the "Y" connected system is therefore 3 times that of the "delta." Partly offsetting this great advantage is an increase in cost of line where single-phase loads are supplied since a fourth conductor is necessary. This conductor, however, may usually be of minimum mechanical strength or say No. 6 copper.

Very effective use may be made of this fourth wire by carrying it at the top of the pole and grounding at every third or fifth pole, thereby serving the purpose of a ground wire to lessen the chances of disturbances on the line during thunder storms. For a balanced motor load this fourth conductor may be omitted although if this is done it is ad-

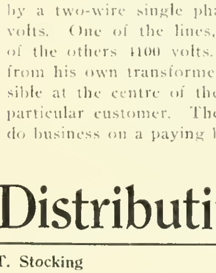


Fig. 1

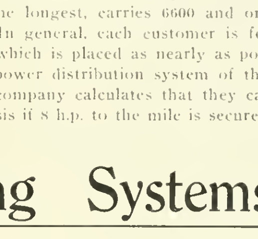


Fig. 2

visable to ground the neutral of the apparatus at both the transmitting and the receiving end.

Other disadvantages are an increase of 10 to 30 per cent. in meter costs; 10 per cent to 20 per cent on the cost of motors for use on line voltage, and frequently an increase in cost of switching and protective apparatus. Greater care is also necessary in keeping the line clear of accidental grounds since a ground that would not seriously affect a delta system might result in a short circuit where a grounded neutral is employed.

Considering a lighting load only, the cost of line will be the chief factor in selecting the system. Assuming 5 per cent.

as the maximum allowable potential drop a single-phase 2300 volt line of minimum size—i.e. No. 6 copper—will carry a load at 100 per cent. power factor of about 80 h.p. a distance of 1 mile. A 3-phase, 2300 volt line will carry twice this or 160 h.p., while a "Y" connected 4000 volt system will carry 6 times the first or 480 h.p.

With a water power plant having a day peak it will not be necessary to consider power losses on the lighting circuits, hence the system to employ, and the size of conductors, may be determined from the regulation required. When, however, the line losses mean a direct increase in the cost of power such losses should be reduced to a point where the annual cost of same about equals the annual charges on conductors erected since the total annual cost is then reduced to a minimum. Considerable judgment is often required in deciding just what the load for the year and the resulting annual losses will be.

Assuming the cost of power at the station as $25 per h.p. per year, the cost of conductor erected as $0.26 per lb., with interest at 6 per cent. and depreciation on conductors as 2 per cent. the economical load at 100 per cent. p.f. for No. 6 weatherproof copper with a single-phase 2300 volt line may be found as follows:—Cost, erected, of 1 mile of two No. 6 T.B. weatherproof copper conductors would be $310. Annual charges at 8 per cent. = $24.80, which would be equivalent to the cost of

$$\frac{24.80}{25} = .992 \text{ h.p.} = 740 \text{ watts}$$

for line loss.

The resistance of 1 mile of No. 6 copper single-phase line is about 4.18 ohms and watts loss = C^2R,

therefore $C = \frac{\sqrt{740}}{\sqrt{4.18}} = 13.3$ amperes which at 2300 volts = about 41 h.p. Similarly it may be found that economical load for a 3-phase line of No. 6 copper and 2300 volts is about 71 h.p. and for a four-wire, 4,000 volt line is about 143 h.p. In the following table are given the annual costs per mile, including line costs and losses, of transmitting various loads with different systems. Prices of material and of power are as assumed above. In the 4,000 volt system is included the cost of the neutral with its support erected and wire grounded at every fourth pole, the neutral wire in all cases being No. 6 triple braid weatherproof copper. Prices do not include the cost of poles, cross arms, etc., as these are practically constant for all three systems.

Size Copper	No. 6			No. 2			No. 2/0		
Volts	2300	2300	4000	2300	2300	4000	2300	2300	4000
Number of Wires	2	3	4	2	3	4	2	3	4
Annual Charge on Conductors..	31.00	46	67	72	108	129	140	210	231
H.P. carried 1 mile with 5% volts drop	60	120	360	150	300	900	285	570	1710

ANNUAL COST PER MILE PER H.P.

H.P.	No. 6			No. 2			No. 2/0		
20	1.84	2.45	3.40	3.71	5.45	6.47	7.05	10.50	11.55
40	1.36	1.45	1.75	2.04	2.82	3.26	3.62	5.32	5.80
60	1.40	1.21	1.27	1.55	1.97	2.21	2.52	3.60	3.88
100	1.70	.75	.91	1.30	1.37	1.39	1.70	2.25	2.35
150	1.70	1.41	.81	1.36	1.16	1.01	1.37	1.62	1.61
200	3.10	1.70	.82	1.53	1.13	.84	1.29	1.34	1.25
300	—	2.36	.96	1.99	1.23	.72	1.34	1.14	.92
500	—	3.77	1.35	3.41	1.67	.74	1.74	.95	.70
1000	—	—	—	—	3.03	1.09	—	1.67	.71

Under the conditions assumed above it would be uneconomical to use a single-phase system for transmitting more than about 50 h.p. For loads over 100 h.p. it would appear advisable to employ the "Y" connected system and this would doubtless be true for lighting loads since only the metering and switching apparatus at the station would be affected causing only a slight additional cost, while two station transformers would still be effective if the third were damaged. The regulation also would be very much improved which in itself is an important consideration.

Where a motor load is carried, owing to the lower power factor and the resultant increased line losses it will be economical to use the 4-wire system—on somewhat lighter loads—considering transmission only. If the motors are to be supplied at voltages lower than 2000 this may hold, but where they are to be connected directly to the line the increased cost of motors, starting devices and meters will lessen or perhaps entirely overbalance the saving on transmission.

The increase in cost in motors with starting devices is due largely to the latter, although, no doubt, the increase is to a great extent caused by the fact that 4000 volt apparatus has not become a standard in Canada.

In the switching apparatus to handle the same load there should be little difference in price as the neutral wire may be permanently grounded at the load and there is no necessity of breaking it, hence the ordinary 3-pole oil switch may be employed.

In meters, however, working on unbalanced loads using the fourth wire there is a considerable difference in cost since three current transformers are required in place of the two as ordinarily used. Assuming the total cost of meters both for the station and the customer as $2 per h.p., with annual charges of 14 per cent., and of motors with starting devices as $13 per h.p. with 12 per cent. annual charges, station switching and protective apparatus $2.50 per h.p. with 12 per cent. annual charges; then an increase of 30 per cent. in cost of meters, 20 per cent. in motors and 20 per cent. in station

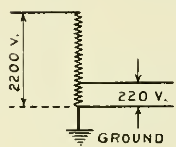


Fig. 3

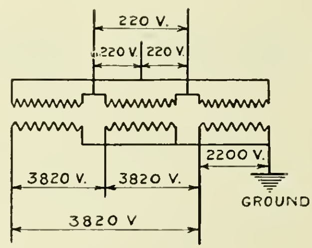


Fig. 4

protective and switching apparatus will increase the annual cost by .08 + .31 + .06 = $0.45 per h.p.

Again when a "delta" system is adopted two transformers will still be effective for supplying 3-phase current after the third has been damaged which is not the case with the "Y" connected system and for this reason it may be advisable to install a spare transformer. Assuming the cost of transformer installed as $12 per h.p., then the annual charges for the spare taken at 12 per cent. per annum, will increase the annual cost per h.p. by $0.48, bringing the total extra cost above that of the delta system up to about $0.93 per h.p. per annum. This figure should cover the additional cost in the most unfavorable case and usually this cost may be made much less.

Two or more 3-phase transformers may be substituted for the bank of three single-phase transformers bringing the cost down to little in excess of the latter and making the service fully as good. In many small stations the motor load is of such a nature that an interruption of one or two days would not be serious and therefore would not necessitate spare transformers or the whole system could be changed temporarily to V. On these stations the motor loads are small and are usually supplied at a potential lower than that of the line. In such cases no additional equipment is required at the motor, the only additional cost being in station switching and meter equipment. The additional

cost here would probably not exceed \$0.15 per h.p. per annum.

Generally speaking for a mixed load where regulation is not a factor it would be quite safe to install the "Y" connected system when the annual saving on transmission costs reaches \$0.50 per h.p. On the longer lines where it is necessary to consider regulation it would doubtless be wise to use the "Y" system on much lighter loads than would appear from an examination of the above figures.

In connection with this system various engineers have advocated the use of auto transformers for service use as

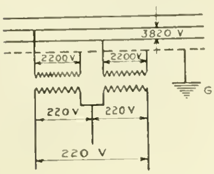


Fig. 5

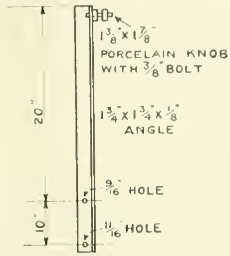


Fig. 6

shown in Fig. 3. This would considerably reduce the transformer costs and should not be objectionable providing a good ground is assured. Some companies have even discarded the neutral wire and depend entirely on the ground wire for single-phase work. This would, however, become dangerous unless it is known that one side of the secondary is permanently and absolutely grounded. Fig. 4 indicates a common method of connecting transformers with "delta" primary to "Y" secondary or vice versa. Some care must be taken in making such connections since it is possible to obtain unequal potentials between the different secondary wires, and it is advisable to test with a volt meter or lamp bank before connecting to load. For supplying a motor load from two transformers the connection shown in Fig. 5 is used and may be employed either on light loads to save transformer costs or as a substitute for three transformers in case one is damaged.

The question of what form of conductor to use for the neutral wire and how this conductor should be supported is one that requires considerable thought. With the lighter loads since little current is carried, mechanical strength is the chief consideration. For such cases copper clad steel and even galvanized iron has been proposed and would no doubt serve quite well on such loads particularly when grounded at frequent intervals. Its chief use in such cases would really be to assure an absolute ground and, when properly erected, to answer as lightning protection.

Whether or not this neutral wire should be insulated would depend upon its position on the pole as well as on the type of the other conductors. If the latter are bare the neutral would naturally be. If the neutral is located close to insulated primary conductors where linemen are liable to come in contact with it while working on live lines it is advisable to have the neutral insulated. This also applies to the grounding wires. If the neutral can be supported in a more or less isolated position such as well above the upper arm there appears no necessity of insulating it and the saving on cost of insulation may be used in raising it still higher thereby making it more effective as a lightning protection. Various types of pole top brackets are on the market and serve nicely in cases where the arm can be placed well down on the pole. A short heavy porcelain knob secured by a lag screw to the top of pole also answers well, the porcelain being the cheapest article obtainable with smooth surfaces which will not injure the wire. Where an iron wire is employed as neutral an iron clamp may be substituted for the knob.

For carrying the neutral well above the top of pole an angle iron fitted with a porcelain knob, as shown in Fig. 6, is probably the simplest device that can be made. The through bolt for supporting the cross arm may be used as the lower bolt for this support, thereby saving a bolt and two washers. In using such a device it is advisable to carry the neutral on an insulator of some description to avoid danger to linemen. For the same reason the grounding wire should be carried up without touching this suport.

There is, of course, no necessity of using special construction for this neutral wire, the only object of carrying it at the top being to have it serve as a protection which might considerably improve the service and at the same time make it possible to discard at least a portion of the lightning arresters.

Wireless Stations on Hudson Bay Railway

Under a contract between the Marconi Company of Canada and the Federal Government, two wireless stations will be erected at the terminals of the proposed Hudson Bay Railway—one at Port Nelson on the Hudson Bay, the northern terminal of the line, and the other at Le Pas, Manitoba, the connecting point of the new line with the Government railway system. These stations are primarily intended to serve as intermediaries for the ordering and forwarding of material and labor from the base to the scene of operations, and will greatly facilitate the work of construction. The stations will be of 10 kw. capacity, the power being obtained from 20 h.p. Canadian Fairbanks-Morse engines, and each station will have a range of 500 miles. It is probable that the stations may form the commencement of a wireless chain extending through northern Ontario and Quebec and the Hudson Bay straits, eventually linking up with the Newfoundland Government stations on the Labrador coast.

Convention Rejuvenation

When it was definitely decided to hold the Canadian Electrical Association Convention in Toronto, the Jovians immediately began to prepare for a rejuvenation to take place on one of the convention dates. The necessary arrangements have been made and the committees are at work perfecting the details for this gala event, which will take place on June 27th at 8 o'clock. All Jovians are invited to attend, and members of the C. E. A. who are not Jovians are advised that they can obtain application blanks and the necessary information from any member of the Toronto managing committee, consisting of E. B. Pike, H. G. Nicholls, M. P. Ellis, W. W. Lovell, S. C. DeWitt, B. O. Salter, Jno. Ward, secretary and treasurer, and A. Ross Oborne, chairman of the membership committee. The Jovian order in Toronto have issued an attractive folder calling attention to this rejuvenation. They point out that there are to-day over 10,000 members of this order, and that their worthy slogan "all together, all the time, for everything electrical," should appeal strongly to all good men in the electrical business.

Mr. Irving Smith, 809 Unity Building, Montreal, has secured the agency, for Canada, for the Delta-Star Electric Company, of Chicago, manufacturers of high voltage disconnecting switches and high voltage disconnecting gear and fuses.

The Makers of Electrical Canada

COL. SIR HENRY MILL PELLATT, C.V.O.

A man may be known in military circles as a soldier of renown and as a generous patron of the military arts; he may be a financier with world-wide reputation for wisdom in council and honor in all his dealings; he may be the holder of athletic records and have made a mile in faster time than any other athlete on his continent—but any one of these takes second place to the man who advances, not one stage, but many, the universal utilization of electricity by showing how it may best be developed, demonstrating its commercial possibilities and backing his faith by a final demonstration that eclipses anything the world has seen. And what then of one man who combines all these qualities. This is Col. Sir Henry Pellatt, C.V.O., the subject of this issue's sketch and a true maker of electrical Canada.

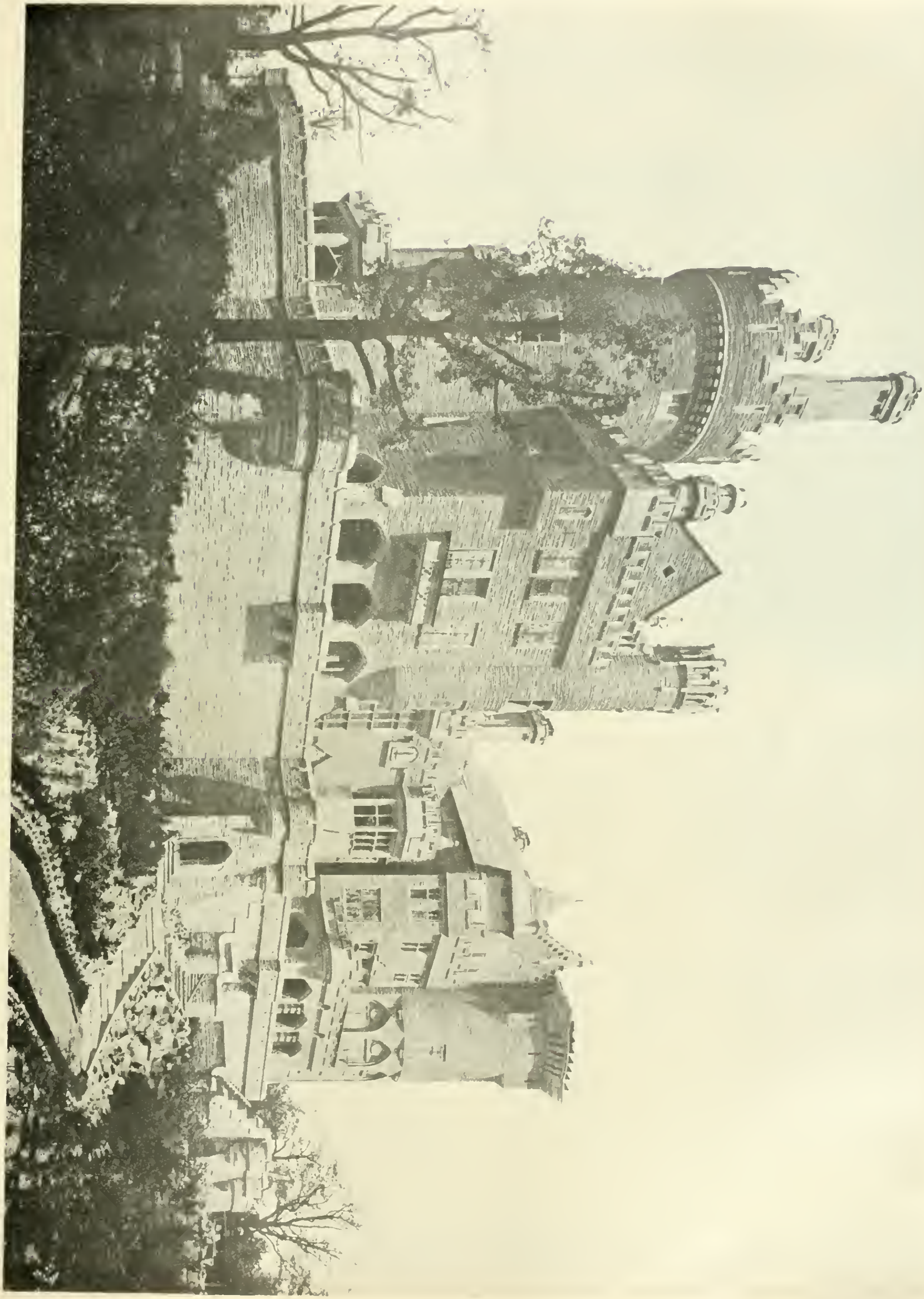
It is not generally known to the younger generation that in 1879 the then "Harry" Pellatt was the fastest "miler" on the continent of North America winning the title by defeating Duffy in 4.32, the fastest time on record, with one exception, to that date. Previous to this Sir Henry had been champion athlete of the Toronto Model School, in 1875, and of Upper Canada College in 1876. A little later he also won special mention as a member of the first team of the Toronto Lacrosse Club. Even yet Sir Henry is said by those who know him intimately to be as "hard as nails," the result not only of his early training, but also of an hour spent, even yet, each morning in his own gymnasium.

Sir Henry M. Pellatt.

In military matters Sir Henry's achievements, having been more recent, are more widely known. In his youth he became a private in the Queen's Own Rifles, the largest volunteer corps in the Dominion, with which regiment he has since been continuously and prominently associated, retiring but recently with the rank of Colonel. In 1897 it will be remembered that he commanded a section of the Canadian contingent which visited England on the occasion of the Queen's jubilee. Later, at the Coronation of King Edward he received command of the Canadian contingent and took with him, at his own expense, the Queen's Own bugle band. In 1910 he again, at his own expense, took his whole regiment of over 600 men to England to take part in the manoeuvres of the British army at Aldershot. It was for his military achievements, to which he was chiefly impelled by strong imperialistic convictions, that he probably owes, more than to any other single phase of his life's work, the honor of receiving, in 1905, recognition for his services in the title of Knight Bachelor.

Sir Henry began his financial career in the brokerage office of his father, the senior member of the then firm of Pellatt and Osler, the other member of the firm being Sir Edmund Osler, M.P. In 1882 this firm was dissolved and the business has since been carried on under the time-honored name of Pellatt and Pellatt, of which Sir Henry, since 1891, is the senior member. But his broker's office can scarcely, especially in recent years, have received any large proportion of his time, which has been occupied in the development of many industrial and other enterprises, in which he has interested himself for the building up of Canada. For example, aside from electrical companies about which we shall speak later, he is connected in one capacity or another with the Dominion Steel Corporation, the Richelieu & Ontario Navigation Company, the British & Colonial Land & Securities Company, the British Canadian Shipbuilding & Dock Company, Steel & Radiation, Limited, the British Columbia Packers Association, etc. To these he gives freely of his time, ability and sagacity, and it is noticeable that success attends the enterprises he associates himself with.

But above all these is Sir Henry's interest in matters electrical. He it was who was largely instrumental in the erection of that pioneer, but still unexcelled, hydro-electric development at Niagara Falls, the Electrical Development Company's plant. This was followed by the Toronto & Niagara Power Company, a transmitting company which placed Toronto for the first time in the limelight of Niagara's incandescence. The Toronto Electric Light Company for the distribution of light and power was the natural sequence and of all three, Sir Henry Pellatt became and remains president. Indeed Sir Henry has been prominent in the councils of most of the big electrical successes of the past decade including Twin City, Toronto Railway, Sao Paulo, the reorganized Toronto Power Company and the latest development, the Brazilian Traction Light & Power Company. He has had faith in electricity, and has demonstrated his faith in a practical, tangible way by staking both his reputation and his fortune in its developments. Of his latest and crowning achievement, an installation of electrical equipments in his own new mansion which, so far as we can learn, will stand without a parallel the whole world over, we speak at length in other pages of this issue. Sir Henry was born in Kingston, Ont., in 1860.



The magnificent mansion of Colonel Sir Henry M. Pellatt, Davenport road and Spadina avenue.

The Electrical Equipment of "Casa Loma"

The magnificent new mansion of Col. Sir Henry M. Pellatt—An intricacy and refinement of electrical control without a parallel in the world.

The palace of Col. Sir Henry M. Pellatt, occupying, with grounds, some 15 acres on a commanding eminence at Davenport Road and Spadina Avenue, Toronto, and now nearing completion, is undoubtedly a masterpiece of architectural design and beauty, but is still more interesting from our point of view, in that the electrical installation represents the most complete and thorough adaptation of all the electric arts to a private residence that the world has seen. And in this statement we are not unmindful of the magnificent luxury of the Astors, Vanderbilts, Clarkes, Schwabs and Carnegies of our neighbors to the south. In point of clever and intricate refinement of control, completeness, practicability and magnificence the electrical installation in Sir Henry Pellatt's mansion will be without a peer in the whole world. This has been the avowed ambition of the owner. Sir Henry is a man deeply interested in the progress of electricity and takes a keen delight in its triumphs, and there is no doubt that this installation will long remain an outstanding monument to the possibilities of the industry he has done so much to promote.

Some conception of the ideal in the mind of the owner of this beautiful mansion may be gathered from the accompanying views of the exterior of the buildings, but undoubtedly the climax of engineering skill has been reached in the intricacies and magnitude of the electrical equipments, which in point of size are such as would be installed in a large town or small city. The number of lamps required in all will be between four and five thousand 50-watt unit equivalents which, with motor installations and heating units, will bring the maximum requirements into the neighborhood of 400 kw.

A brief mention of a few points of special interest in connection with this installation will serve to give the reader some conception of the scale on which the work has been carried out:—Current will be transformed within the mansion from 4,000 volts to 550, 220 and 110 volts and distributed at either 25 cycles or 60 cycles as desired. A main switchboard of 11 panels, a distributing switchboard 35 ft. long by 8 ft. high, and a dimming machine will, on account of their size, occupy separate rooms. The distributing board will be of the finest Italian marble, and will be housed in a room walled and ceilinged of the same; this board will be operated by remote control only. The lighting requirements of the mansion will be fed by 150 1-in. conduits containing three circuits each on the average, or a total of 450 circuits. The lamps will be controlled by selector switches, generally 13 point. At four different locations in the mansion every light in and around the buildings will be under the control of one master push button. Thirteen master-selector boards operate 128 dimmer control circuits. Eighty-four picture dimmer switches control the art galleries. The cables for the control and dimming equipments will be carried in upwards of 100 2-in. conduit, and for the most part will be 75-wire cables. Finally, the telephone system will consist of 32 sets connected by four trunk lines with a central city exchange.

In the following article these various points of interest will be described at greater length and in detail.

Transformers

The incoming main is a 4000/2300 volt, four wire, 3-phase, 25 cycle line. One 150 kw. 2300/125 volt, 25 cycle unit will supply current for lighting. One 150 kw. 4000/550 volt, 3-phase, 25 cycle unit will supply current for motors throughout the main building, and one 40 kw. 4000/220 two-phase, 25 cycle transformer will supply the motors in the stables, conservatory, etc. In addition to the transformers there will be a 150 kw. 2300/125/250, 25/60 cycle frequency changer set so that when required the mansion may be lighted with 60 cycle current. In this same room will also be installed duplicate sets of 25 kw. 20 volt motor generators for the control of the relays and the call-bell system throughout the building. There will be no batteries installed. The motor generator sets will be so equipped that should one fail to operate, the second one will be cut in automatically.

Main Switchboard

The main switchboard will be of blue Vermont marble mounted on an angle iron frame, and will consist of eleven panels to be used as indicated below. A swing bracket will carry a voltmeter for the incoming line; a voltmeter for 3-phase, 550 volt power; a voltmeter for 2-phase, 110-220 volt light; and a frequency indicator.

Panel No. 1 will be used for the incoming line and be provided with a 100 amp. oil switch with time limit relay; a 300 kw. watt-hour meter; three ammeters; potential receptacles; and four single-pole disconnecting switches.

Panel No. 2 is the lighting transformer panel controlling 4000/2300 to 125/250 volt, 2-phase, 25 cycle current. It will be provided with a 100 amp. single pole oil switch; three ammeters; potential indicator; and four disconnecting switches.

Panel No. 3 will be used for controlling the current for opening and closing the coils of automatic switches on the distribution board. There will be two circuit breakers mounted on this panel electrically interlocked, so that one breaker will automatically close if the other breaker opens and thus insure a perpetual supply of current for the operation of the automatics.

Panel No. 4 will be used as a lighting transfer panel, and will be provided with two solenoid control interlocked circuit breakers, so arranged that the breaker connected to the 60 cycle frequency changer set will close as soon as the frequency changer has come up to full voltage, and at the same time will open the circuit breaker furnishing 25 cycle current for the lighting system of the house.

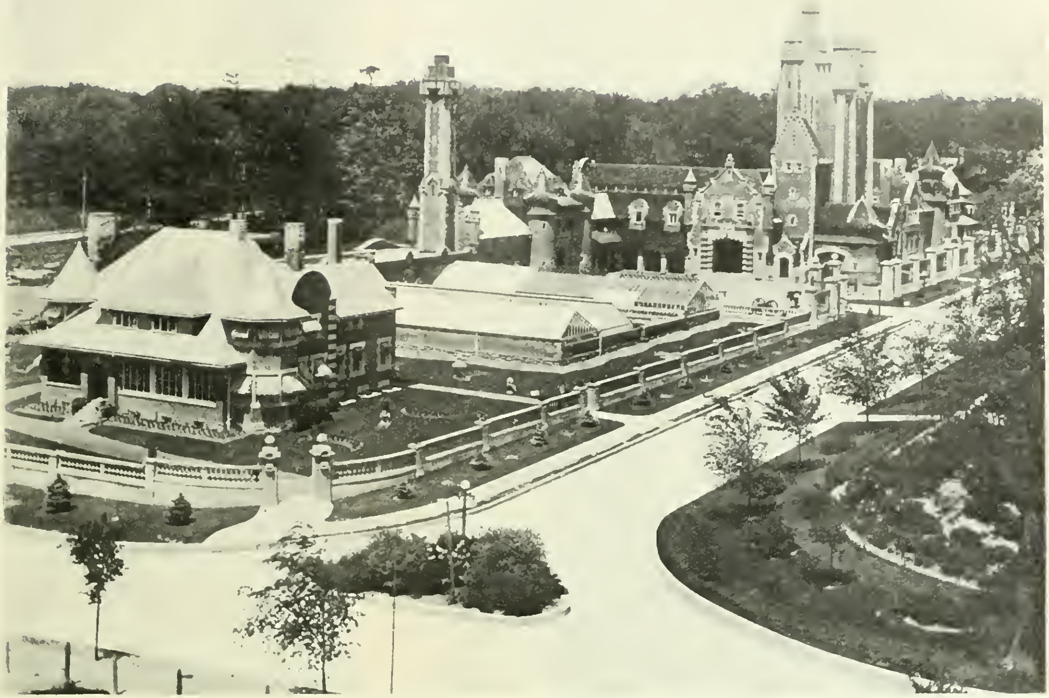
Panel No. 5 is a frequency changer panel to change from 25 to 60 cycles, and will be provided with an oil-switch with time-limit relay, potential receptacle, three ammeters, and one field ammeter for generator.

Panel No. 6 is the general power transformer panel and takes care of the 150 kw., 500 volt, 3-phase power transformer. It is provided with automatic oil switch; time limit relay; three ammeters; potential receptacle and disconnecting switches on the 4000 volt line.

Panels 7 and 8 are power feeder panels and are provided with over-load and no-voltage automatic circuit breakers for the control of motors, elevator, refrigerator, laundries, circulating pump, sump, dumb waiters, and two remote control over-load and no-voltage contactors for exhaust fans.

Panel No. 9 is the motor control panel for the two 20-volt motor-generators and is provided with two motor starters for starting the 550 volt motors directly connected to the 20 volt generators.

Panels 10 and 11 are for the control of the 20 volt generators. Each is provided with an ammeter, voltmeter, rheostat, disconnecting switch and double pole solenoid operated circuit breaker. The two breakers for the two generators are so interlocked with the motor starters on panel No. 9



View showing lodge, conservatories, stables and a corner of the garden.

that the opening of either of the breakers will open the motor starter on the corresponding motor and close the motor starter on the other motor so that there will be an uninterrupted supply of 20 volt d.c. current for the operation of relays which are controlled by the master and the grand-master boards located in different parts of the building.

The Conduit System

The lighting wires will be carried in something over 150 1-in. conduits to the different parts of the mansion. Leaving the distributing board 100 of these conduits lead upwards to the ceiling of the main hall and pass, 75 to the east and 25 to the west side of the building. One of the photographs reproduced herewith shows a view of the ceiling of the main hall during construction. Each conduit encloses three circuits for the most part, though occasionally four are installed. The 100 conduits are distributed as follows: 10 lead to the library, 7 to the dining room, 11 to the palm room, 5 to the main corridor, 14 to the lower picture gallery in the main hall, 11 to the servants' quarters, 12 to bedrooms on the second floor; these are all for lighting purposes. Five others will carry power wires, one to the refrigerator motor, one to the circulating pump for the plunge bath, one to the laundry machinery, one for heating appliances in the kitchen and one for heating appliances in the butler's pantry. The motors are all 550 volt type. The heating currents are 110 volts.

The 25 conduits running westward from the main hall carry wires for lighting as follows: 8 to the drawing room, 5 to the smoking and billiard room, 6 to three suites on the second floor and 5 for the grand staircase and great hall.

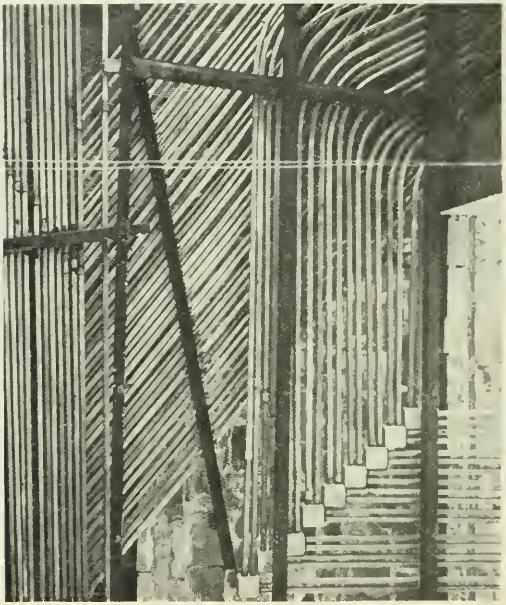
The conduits which carry wires for the basement lighting are distributed, two for the plunge bath lights, one for the gymnasium, two for the bowling and recreation rooms, one for basement billiard room, one for transformer room lighting, two for basement corridor and staircase, one for corridor leading to tunnel, four for lighting the 3rd floor, four for lighting the five ceiling fixtures in the great hall and three for pictures and corridor lighting on the second floor. Two conduits are also installed for the supply of 550 volt current for the pipe organ motors and two more for the exhaust fans.

Cables

The conduit service described above includes only the lighting and power equipment, but a large number of cables mostly enclosed in 2-in. conduits will be installed to control the dimming and momentary switches. For the most part the cables are 75-wire but the complete list with the function each fulfils, is as follows:—One 75-wire cable leads to the palm room for the control and dimming of 400 lights at that point. One 75-wire cable controls the dining room in a similar way; one 75 wire cable controls the library; one 75-wire cable controls the drawing room; 42 75-wire cables control as many individual pictures in the main art corridor; 42 75-wire cables will control similarly the upper art gallery; one 30-wire cable will control the dimming of the ceiling lights in the main art corridor; one 75-wire cable controls the upper main corridor and the grand staircase; two 50-wire cables control the great hall and entrance; one 30-wire cable controls the balcony and terrace; two 5-wire cables control the exhaust fans. The grand-master boards will also

require four 75-wire cables for the control of all the lights in the mansion and grounds. These will be placed as follows:—One in Sir Henry's chambers, one in Lady Pellatt's boudoir, one in the main entrance and one in the servants' quarters.

No. 18 wire is used for the control system throughout. No. 12 for the lighting and No. 10 for the power circuits. The conduit for the distribution system was supplied by the Conduits Company, Limited, of Toronto. The condulets,



Ceiling view in main hall showing some of the conduits containing lighting wires.

cable, transformers, frequency charger set and two 20-volt motor generator sets are being supplied by the Canadian General Electric Company. The installation of the distribution system is being carried out under the immediate supervision of Mr. J. E. Curran. The distribution switchboard and its functions are described in detail below.

Distribution

The lights throughout the mansion will be controlled by thirteen master-selector boards. Each of these boards is provided with a 15-point dimmer switch, a master switch and selector switches.

The dimmer switch is a specially designed 15-point equipment so arranged that by turning the handle of the switch to a point indicating the desired shade of lights the dimmer will automatically produce the desired shade.

The master switch is for the purpose of controlling the lights collectively while the selector switches are for the purpose of controlling the lights individually. Each of the selector switches is provided with an indicating lamp.

These master boards are very compact, being about 5-in. wide by 15-in. high for a board of about 20 selector switches, a dimmer switch and a master switch. The master and selector switches, however, are independent of one another. Many of the circuits throughout the house are controlled by more than one master board. To close or open the circuits individually, press the "on" or "off" button of the selector switches. To close or open the circuits collectively press the "on" or "off" button of the master switches.

In addition to the master boards there is an emergency system of lighting. Grand-master selector boards for emergency lighting are installed in four different parts of the building. These boards are independent of the master-selector boards and each of them has one master switch, one dimmer switch and 25 grand-selector switches, each with an indicating lamp. This emergency system is for the purpose of making it possible to turn the lights on in every part and room of the building as well as in the standards on the grounds and the boulevard lights, no matter whether the switches controlling the circuits are in the "on" or "off" position or whether the lights are controlled by automatics or plain circuit switches. Every room of the building will be lighted in full by pressing the "on" button of the grand-master switch of any one of the four grand-master boards. All lights dimmed at the time the grand-master system is used will be turned on to full brightness by pressing the "on" button of the dimmer switch.

The grand-selector buttons will light only certain rooms or sections of the building. The grand-master switch will control most of the circuits, controlled by the grand-master boards, while the grand-selector switches will control certain circuits of each of the master boards. Further, while the turning "on" of the grand-master or grand-selector switches will turn on all lights not already lit, the turning "off" of the grand-master or grand-selector switches will not turn off any lights which were on at the time the grand-master or grand-selector switches were operated.

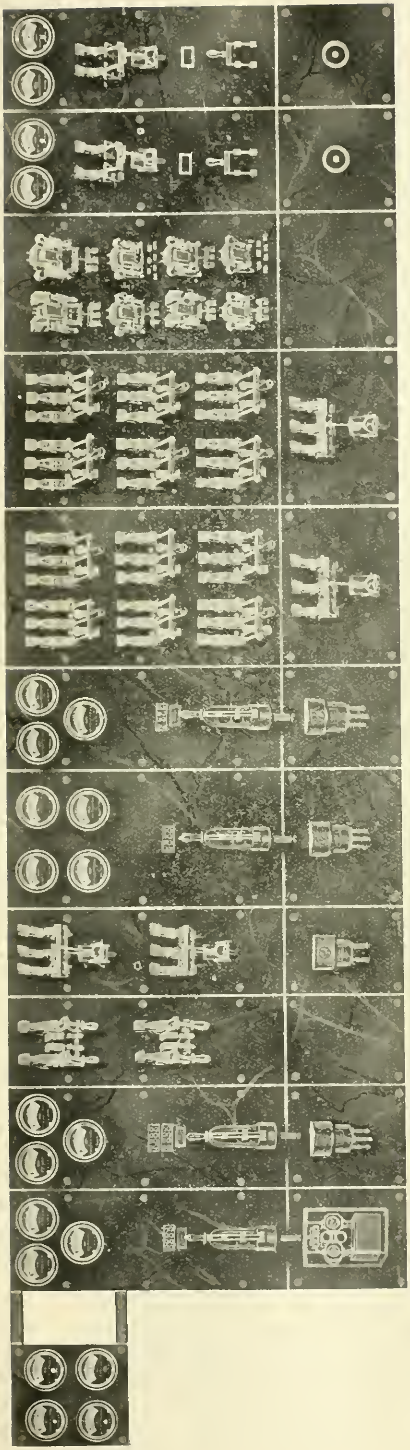
The master-selector as well as grand-master selector boards are connected to relays which operate the automatic switches located in the distribution switchboard room.

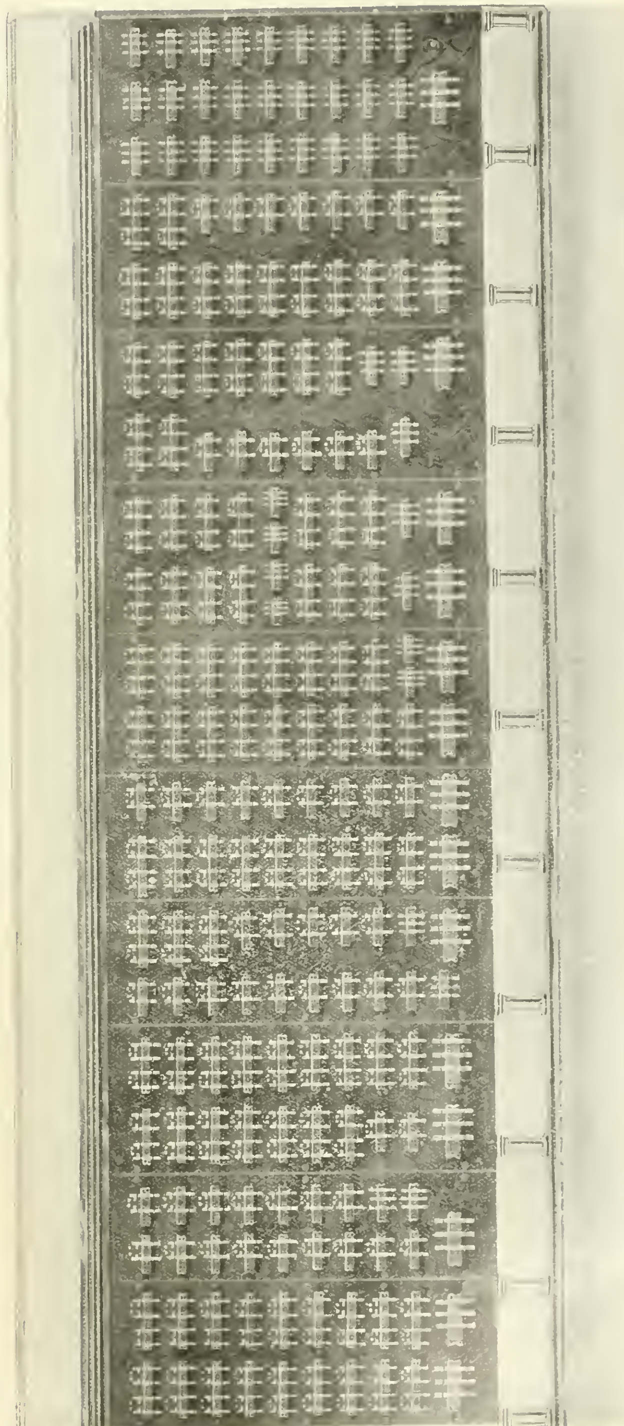
Distributing Switchboard

The piece of equipment in this whole installation which stands out pre-eminently is the distributing switchboard and

Tunnel connecting main building with stables, etc.

the room in which it is being installed. The switchboard will be of the very finest grade of Italian marble known as Blanco P. This is the most beautiful marble in the world, very hard and of uniform color, being slightly creamy in shade. The board when full extended as shown herewith measures 35 ft. x 8 ft. It will be installed along three sides





Switchboard Equipment for Casa Loma. The upper figure represents the Main Switchboard as it will appear when completed. The lower shows part of the distributing switchboard full extended; this board is 35 ft. long and will be set around three sides of the switchboard room.

of the switchboard room. This board will extend right to the ceiling of the room which contains it, and the ceiling itself will be finished in exactly the same quality of marble.

The switchboard will be mounted on an angle iron frame with tool-finished copper pedestals which rest on a black marble base, see figure. The base is of the sanitary base type, the projecting part being flush with the marble tiling of the floor. At the top of the switchboard there will be a marble moulding, but as noted above, the space between the ceiling and this moulding will be enclosed also with this same quality marble so as to give a uniform appearance to the whole room.

The door leading to the distribution room will be of open scroll bronze work backed by a polished wire glass panel. In the centre of the panel will be placed Sir Henry's coat-of-arms. The coat-of-arms will also appear on the upper part of the central portion of the switchboard immediately opposite the entrance door.

On this switchboard there will be mounted 152 automatic circuit switches for the control of 152 lighting circuits, and 160 plain circuit switches. The automatic switches are divided into groups as follows: 27 switches are operated by master board No. 1; 14 switches are operated by master board No. 2; 17 by master board No. 4; 19 by No. 5; 36 by No. 7; 6 by No. 9; 14 by No. 10; 19 by No. 11. Master boards Nos. 3, 6, 8, 12 and 13 are controlling lights already controlled by the other master boards.

One hundred of these automatic switches are controlled by the grand-master board as well as by the master boards and 70 of the plain switch circuits are controlled by the grand-master board.

The necessary master switches for each group will be installed on this board as well as the switches needed for the operation of the circuits controlled by the grand-selector switches. In addition to this there will be an automatic switch, 70 kw. capacity, for the control of lights in the stable, greenhouse, conservatories, lodge, Italian garden, and for electric fertilization. One of the features of the Italian garden will be a beautiful electric fountain. The board will also contain one automatic switch for the control of the standards of the lawn and one for the automatic control of the boulevard lights. Each of the standards and boulevard lights will have a capacity of 500 watts.

The illumination of this distribution room will be by indirect units from the ceiling. The rear of the board will be lighted by means of bulls eyes in the terminal boards. The illumination will be controlled from the threshold in such a manner that a person approaching the door completes the lighting circuit and on leaving breaks the circuit.

The walls behind the board will be finished in plain Italian marble. No wires of any kind will appear at the back of the board. The bus-bars for the lighting system will be painted cream color and the emergency bars black. Each circuit switch is provided with a name plate on both the front and back of the board. Access to the pole box behind the board is by means of hinged bronze panel boards securely held in position by means of vault handles and vault handle bars.

The circuits are protected by means of N. E. C. fuses for circuits of 30 amperes or less, and by copper fuses for over 30 amperes. The necessary master switches for each group will be installed on this board.

Dimmers

The dimmers are all remote controlled and motor operated, and the board for these will be located in a room adjoining that in which the distribution board is placed. Each dimmer will have 55 steps and is provided on the control board with 15 shade sections, so as to divide the light into 15 shades between full light and dark. Each gang and each individual dimmer has its own control board and actuating means between the control board and dimmer and terminal board, all of which forms one unit so that when replacing the dimmer it will be impossible to make a wrong connection between the dimmer and the wires operating the control board of the dimmer. The lights will be brought from full light to dark and vice versa in one half minute or two seconds to each of the 15 shade sections.

The different circuits are controlled by dimmers as follows: 27 of the circuits on group No. 1; 5 of the circuits on group No. 2; 17 on group No. 4; 19 on No. 6; 34 on No. 7; 14 on No. 10; 12 on No. 11; groups 3, 5, 8, 9, 12 and 13 are already controlled through other groups.

There are also 84 circuits controlling the lights in the picture gallery, one set to each picture, so as to be able to secure the particular shade of illumination best suited to each individual picture. All other dimmers are controlled in gangs only so there will be one uniform shade of light throughout the section illuminated by the dimmer controlled circuits.

All controlling wires from the dimmer switches are connected to an inter-connection box, from which connections are made with the control boards of the dimmers, and the inter-connection box is provided with bronze doors. Each of the connections on the inter-connection box is provided with a number for the identification of the wire connected thereto and a directory of the wires is installed on the doors of the inter-connection box.

The door leading to the dimming room will be a duplicate of that installed on the distributing room.

Another feature which is entirely novel, though at the same time most practical, is the method of illumination of the swimming bath. Lights will be installed in a channel cut in the floor of the tank and rendered water-tight by a glass covering. These lights will render a most perfect illumination of any object in the water and will give a very beautiful general effect.

It will be seen that most exceptional consideration has been given to the proper illumination of the art gallery. Each picture is controlled entirely independently of every other picture, both as to the shading and the control of the lamps which illuminate this particular picture.

Typical Lighting Equipments

Each of the 150 conduits carry three circuits of No. 12 copper, except in very rare cases, making a total of 450 circuits. Each of the circuits is calculated to feed twelve 50-watt lamps, so that the total installation, when complete, will be between 4000 and 5000 lamps. Of these lamps the room containing the largest number is the palm room, with 400, a good percentage of which are placed above a glass dome so as to produce a daylight effect. The arrangement of the lamps in the palm room is shown in the accompanying typical diagram representing one corner of the mansion including the palm room, dining room and one end of the art gallery or main hall.

As already stated the palm room is fed by 11 conduits or 33 circuits. The lamps are controlled by a push button master board equipped with 12 pairs of buttons. These are made up of one master button and 11 selectors, each selector having a small pilot lamp installed beside it. The following list indicates the detail of control in this room.

1—Raise and lower buttons for automatic dimmer.
2—Master button controlling all lights.
3—Lamps above glass of dome.
4—Four fixtures at corners of deck beam of dome.
5—Alternate lamps in square of dome soffit beam.
6—Alternate lamps in square of dome soffit beam.
7—Four ceiling fixtures in corner ceiling panels.
8—Eight ceiling fixtures in intermediate panels.
9—Two ceiling outlets on beam at east bay.
10—One light on each pilaster bracket.
11—Two remaining lights on each pilaster bracket.

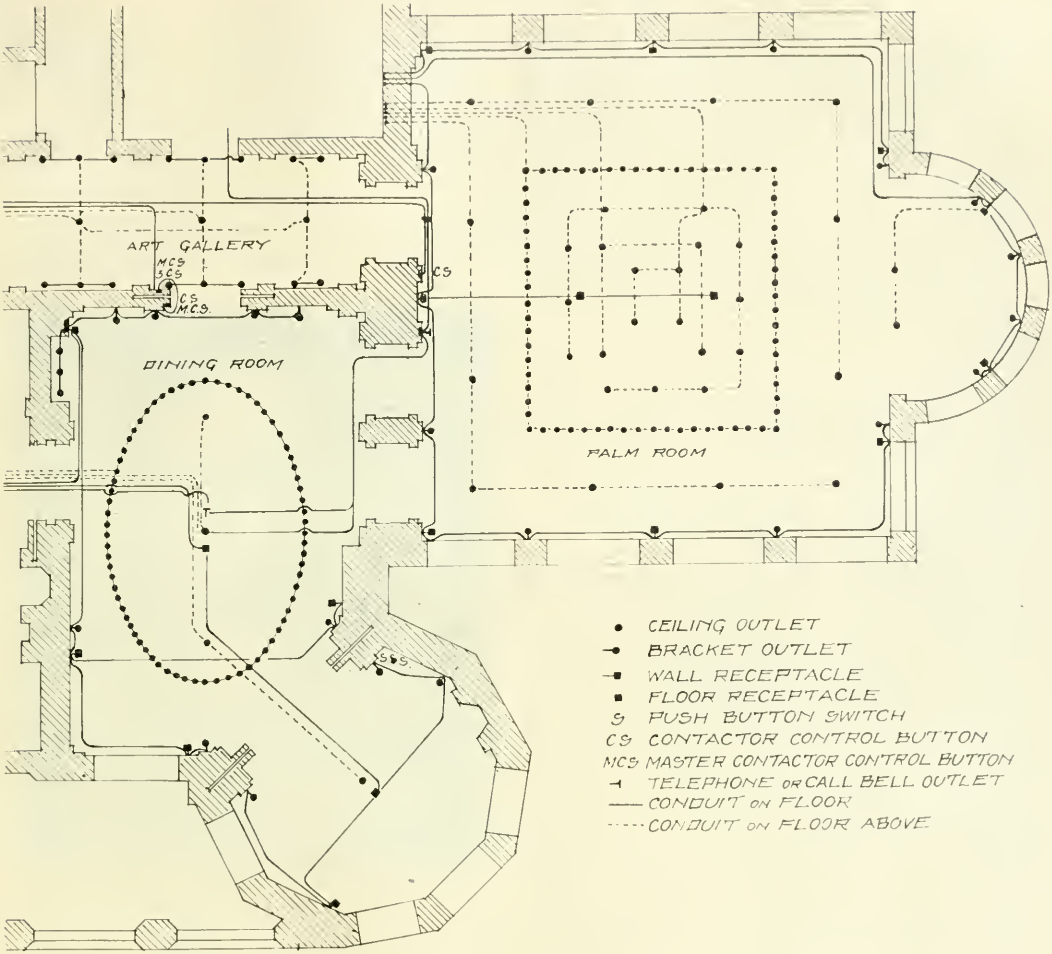


Diagram showing lighting outlets in palm room, dining room and end of main art gallery.

12—All base or floor receptacles.

In the drawing each outlet shown represents a probable installation of four or five lamp units.

The Dining Room

The dining room installation as shown, will require approximately 200 lamps controlled as follows:

1—Raise and lower dimmer buttons for all lights.
2—Master switch for all lights.
3—One-half of centre fixtures.
4—Second half of centre fixture.
5—Two outer ceiling fixtures.
6—One-half of wall brackets.
7—Second half of wall brackets.
8—Sideboard and china cabinet lights.
9—Alternate lights in dome soffit.
10—Balance of lights in dome soffit.
11—Floor plugs and base receptacles.
12—All lights in dining room alcove.

The Telephone System

One of the largest residence telephone systems in America will be installed, consisting of 32 sets connected by four trunk lines with a central city exchange. The system will provide interior communication between all the 32 instruments as well as give an exchange service over the trunk lines from any instrument in the system. There will be no local switchboard, the arrangements being such that any one of the 32 telephones can be called by the city central and vice versa. The sets will be recessed and equipped with a flush plate block of keys. The finish will be specially designed and harmonized with the hardware throughout the rest of the house. The equipment is being supplied by the Bell Telephone Company of Canada, and will be in every respect, one of the most modern of its kind on the continent.

The Heating Plant

The heating plant is located underground in the south end of the stables. The boiler room contains three high pressure boilers of 125 boiler h.p., and each boiler is equipped with automatic stokers. From the central plant the main residence, as well as the stables, conservatories and two cottages are heated by the Webster Vacuum Heating System. An auxiliary hot water heater is provided for the purpose of heating the conservatories during the summer

months. The coal bin has a capacity of 250 tons and is located underground so that the coal may be dumped in from the top. There are two boiler feed pumps with automatic pump governor going into same. The American Blower Company, forced draught system is used for the boilers. There will also be located in the pump room two air compressors for the Johnson Thermostatic Control System by which the temperature of the radiators will be automatically controlled. A 6-inch extra heavy main carries the steam from the boilers through a tunnel 500 ft. long to the main residence. See Figure.

There are three curves of 100 ft. radius in this tunnel. The steam main and the exhaust pipes are anchored in the centre of the tunnel and the expansion is taken care of in each direction by expansion joints. The feeders for the cottages and conservatories are taken from the main in this tunnel.

There are two vacuum pumps, one of which is running constantly in order to keep up the vacuum in the exhaust pipe and return all condensation to the boilers. A 4-inch return main is concealed underneath the floor of the tunnel. The exhaust steam from the pumps is passed through an oil reflector and returned to the exhaust system. The condensation in the main steam line is collected by means of pumps and also pumped into the exhaust system. This work is being installed by the W. G. Cornell Company, of New York, Mr. Henry De Beauher being in charge of the heating work throughout.

In the north end of the residence is the distributing point where the steam is reduced from a pressure of 60 lbs. to 2 lbs. by means of a reducing valve, which is protected by a high pressure bi-pass in case of accident to the reducing valve. From this distributing point the 10-inch low pressure main is run which branches into an 8-inch and a 5-inch main. A 3-inch high pressure main runs from here to the domestic quarters for heating the laundry, swimming pool and for other domestic purposes. It is also desired to cook by this high pressure steam.

The 8-inch low pressure main runs around the south side of the building, distributing to the risers. The basement is heated by means of wall radiators hung from the ceiling. The main floor is heated by both direct and indirect heating. In the indirect heating cold air is brought into the radiators in the basement and passed up into the rooms above, automatically controlled by dampers. The domestic servants' room is heated by high pressure steam in the winter time supplemented by a low pressure auxiliary boiler of 5,000 sq. ft. heating surface for summer use. The pool heater is located in the room underneath the servants' quarters and is used for heating the swimming pool. It is supplied by high pressure steam. A circulating pump of 6 h.p. draws the water from the bottom of the swimming pool, circulates it through the heater and back into the tank. As soon as the water in the tank becomes of the proper temperature the functions of the pump automatically cease. All heaters are automatically controlled by thermostat. All pipes and fittings in the domestic servants' room, pool, heating room and laundry are made of brass. 10,000 ft. of this pipe is installed, ranging in size from ¼ to 4 inches and covered with hard felt sectional covering. The laundry is located underneath the kitchen and is fully equipped and also supplied by high pressure steam.

An ammonia refrigerating system which supplies the refrigerators in various parts of the building is located underneath the kitchen. This refrigerating room is finished in white tile.

The swimming pool, 24 ft. wide by 60 ft. long, is 9 ft. deep at one end and 3 ft. deep at the other. The cold water is taken from the lowest end and circulated through the heater and back through percolators located at the side walls around the tank. Located every 10 ft. around the swimming pool are scum drains.

The pump room is heated by direct indirect heating. The centre pump in the pump room is heated by direct heating to evaporate all moisture.

Roof coils are placed underneath the eaves inside the building to melt all snow and ice which would collect there. All leaders to the roof coils are connected with the steam connection in case of freezing so that the ice can be melted and the leaders be freed. The towers are also heated up to the fifth floor. The risers and branches to radiators are covered with 85 per cent. magnesia covering. All risers and

Mr. William B. Boyd, M.I.E.E.

branches to radiators are extra heavy pipe with Crane fittings suitable for a working pressure of 250 lbs.

Throughout the building there is a system of vacuum cleaning with outlets in all rooms and corridors installed. The motor operating the vacuum cleaner will start automatically on opening any one of these outlets.

All water entering into the building is taken from two water mains on the street and is filtered, even to the water used in the swimming pool. The plumbing system throughout is known as the Durham system and is also installed by the W. G. Cornell Company, in charge of W. O. Wolly.

This unparalleled installation has been made possible through the unremitting activity and attention of Mr. W. B. Boyd, who was given "carte blanche" by Sir Henry, to see that the work was carried through with as little delay as possible, that such labor was employed as in Mr. Boyd's opinion should be necessary, and that the installation should be so complete and so skilfully installed that there could be no possibility of a mistake or hitch in the whole matter.

The switching equipments, including the main boards, the dimmers, and the smaller control boards throughout the installation were designed, manufactured and installed by the H. Krantz Manufacturing Company of Brooklyn, N.Y., for whom Mr. C. H. L. Keeler, Toronto, is Canadian agent.

Testing of Telephone and Telegraph Lines*

A Series of Short Articles Based on the Author's Practical Knowledge and Experience—Applicable to Plant of Any Size or to any manufacturer's Equipment

By Mr. T.H. Nicholson

Arrangement of Testboard

As the design of small testboards will usually depend to a large extent on the apparatus available no attempt will be made here to describe suitable arrangements for such boards, but in the case of larger installations the efficiency of the whole is largely affected by the ease of operation of the testboard so it is profitable to elaborate somewhat on the planning of this part of the equipment. The testboard here described is of the single position type and is given as a collection of ideas that have severally worked out admirably and are arranged to the best advantage of each and to one another. These ideas may be used in the design of a testboard or may be specified in orders covering such equipment.

The testboard may consist of a suitable framework with one or more jack panels and a keyboard for the necessary testing keys and arranged to mount both the voltmeter and Wheatstone bridge flush on it. The auxiliary apparatus and relays for trunks, etc., may be mounted in the rear. The section should be of the low type, that is, with keyboard low enough to permit the use of ordinary desk chairs in that under these conditions less effort is necessary to manipulate the testing apparatus. The voltmeter should be mounted horizontally on the keyboard for the reason that this has been found to be less tiresome on a testman than when it is

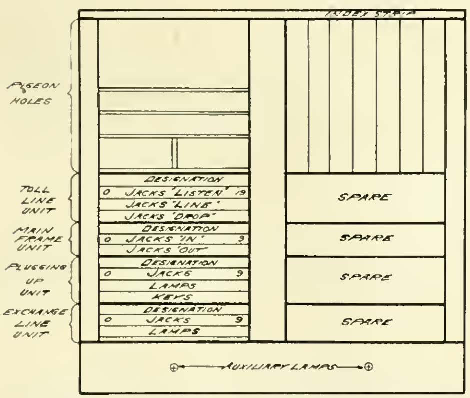


Fig. 1. Typical front equipment of a test board.

located in a panel at an appreciable distance from his eyes. The keys should be of the vertical spring type, and should be of the two or three lever variety if possible so that compound tests can readily be made without any extended effort.

Fig. 1 shows a plan of the face equipment for a single position, two panel section. As will be noted this provides equipment for terminating the test circuits of a small local and toll exchange. There is but one unit of each group of circuits shown for illustration but the actual layout may be as necessity demands. The "Toll Line Unit" is arranged to permit of all toll lines being carried through the testboard, with a jack for listening or superimposing bridging apparatus, a jack that is connected directly to the line and cuts off the office when a plug is inserted, and a jack that is connected to the switchboard wiring and cuts off the line when operated. The "Main Frame Unit" is to terminate suitable cords and plugs to be located on main frame for testing directly on cable conductors. This unit like the toll line unit, is provided with jacks that permit of testing "in" or "out" with rest of circuit cut off. A listening jack is not

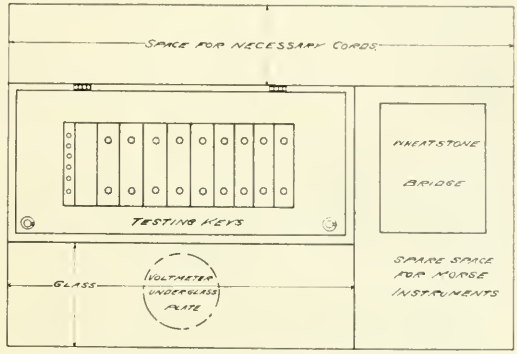


Fig. 2. Typical keyboard plan of a test board.

usually required on such circuits but may be provided if desired. The "Plugging Up Unit" is for circuits terminating on the switchboard on cords and plugs, which are designed to be used on a line in trouble and may be arranged with signal circuits to indicate varying conditions of the line plugged up when desired. Some examples of practical circuits for the above units will be later given under a discussion of auxiliary testing circuits.

Fig. 2 shows a typical keyboard arrangement suitable for testing the class of circuits shown on the units of Fig. 1. On this plan a generous space is provided for cords and

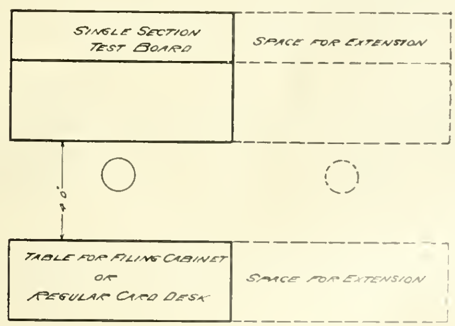


Fig. 3. Typical floor plan of a test board.

keys so that when improved methods are available, or additional facilities are required, they can be provided for without crowding the apparatus to a degree that hinders operating. The general arrangement of this keyboard is one that provides for efficient handling of testing circuits and appara-

tus without the confusion that is often experienced with keyboards that are less uniformly laid out.

Fig. 3 shows a typical floor layout that considers the relation of testboard to filing cabinet. The location of a testboard however will usually be governed entirely by local conditions, so no attempt will be made to suggest possible locations, except to emphasize the importance of good light and close proximity to terminal apparatus.

"Gerrard" Office of the Bell Telephone Company, Logan Avenue, Toronto, Ont.

The Bell Telephone Company of Canada have opened an office building on Logan avenue near the corner of Gerrard street east, in Toronto, and have installed a common battery central office telephone equipment, which has been in service since April of this year.

The growth of the district in which the office is situated is such that its capacity will be required to take care of the growth of the north eastern section, which has been so rapid as to justify and necessitate the opening of this new office.

The building is 110 feet long by 40 feet wide, two storeys and with a high basement, designed to carry another storey in the future. The construction throughout is of the best fire resisting type. The front of the building is finished with red pressed brick and red sandstone trimmings. The design is of a simple dignified character with a large window area, giving the building a maximum of light and air.

The main entrance is on the side towards Gerrard street, the vestibule of which leads into a commodious entrance hall, from which the operators' quarters are entered, occupying the front half of the ground floor fronting on Logan avenue. The operators' quarters contain a large locker room (in which are placed the operators' clothes, lockers and drying closet), lunch room, kitchen, rest and retiring rooms, and sick room. In the basement beneath the locker room, reached by a private staircase, are the operators' toilet and bath rooms.

The rear half of the ground floor is entirely devoted to the housing of the power and terminal apparatus associated with common battery switchboards of the type being installed.

The entire top floor is used as an operating room and contains the subscribers' and incoming trunk switchboards. It is particularly well lighted and well ventilated.

The whole of the central portion of the floor of the operating room, that is between the switchboards, is raised 13½ inches higher than that portion of the floor on which the switchboards stand. This construction permits of the operators sitting on chairs of normal height and, at the same time, more readily permits of their making any connection to the most distant parts of the switchboard which they are obliged to reach. At the same time, access to all parts of the back of the switchboards is exactly the same as in buildings of earlier construction where the entire floor of the operating room is on one level.

A particularly good fire escape is provided outside the building, reached by doors swinging outward from the operating room and from the operators' quarters to the street beneath.

In the basement are situated furnace and coal rooms, men's lavatories, battery room and cable terminal entrance.

The switchboard equipment is of the latest standard common battery relay type and was supplied by the Northern Electric & Manufacturing Company, Montreal.

The lines enter the building underground in lead covered, paper insulated cables and are connected to the main frame by silk and cotton covered insulated cables.

The main, intermediate and relay frames, the coil racks for the lines and in-trunk switchboards with their fuse panels, the power plant and two-position inspectors' desk are located in the terminal room at the east end of the ground floor.

The power plant consists of the main battery of 11-G chloride cells and a smaller set of 11-E-11 cells, the latter battery being used to reinforce the main battery for long distance work.

Two Western Electric Company's motor generator sets are provided for charging the larger battery, one being held in reserve in case of a break down. Each consists of a Western Electric Company's generator of 18,000 watts capacity at 30 volts, directly connected to a 30 h.p., 550 volt, 3-phase, 25 cycle motor. The generators are of a standard telephone design specially built for charging telephone batteries, having a large number of segments in their commutators and with specially shaped pole pieces, the idea being to eliminate noise from the associated telephone service when the battery is being charged. The smaller battery is charged by a smaller generator which has an output of 600 watts.

Two machines are provided for furnishing alternating current for ringing subscribers' bells and with special interrupters arranged to give automatic intermittent ringing of subscribers' bells on calls originating from the other offices. These interrupters also give an interrupted direct current to work the many signalling circuits required for an equipment of this type. The necessary switches, circuit breakers, measuring instruments, etc., are mounted on a black slate switchboard.

From this terminal room the lines are run to the switchboards on the floor above in switchboard cables supported on structural steel runways.

Two separate switchboards are provided, one to care for the subscribers' lines directly connected to this office and the other one, the in-trunk switchboard, to complete connections that originate from the other offices. Both switchboards have a capacity of 10,400 lines and are equipped for 4,000 lines. They are equipped with the latest types of circuits, those of the in-trunk switchboard include the keyless incoming trunk circuits.

All the structural steel telephone apparatus in the terminal room are painted with aluminum paint (not the usual grey iron filler paint) and gives the room a bright and cheerful appearance.

New Wireless Station for Montreal

The Federal Government propose to erect a wireless station on Mount Royal, Montreal, and have asked the city to reserve land 800 feet long by 200 feet wide for this purpose. The station will consist of two wooden masts, 180 feet high and 450 feet apart, and one operating house 40 feet long by 20 feet wide. The erection of the station is due to the increasing number of vessels plying to the port of Montreal. The station will be capable of communication with the Quebec station to the east and the Kingston, Ont., station to the west, thus linking up the Government wireless stations on the Great Lakes with that on the east coast, and completing a chain of stations which will extend from Port Arthur at the head of the lakes to Cape Race and Belle Isle on the Atlantic. There is at present a station in Montreal, but it has a very limited range which cannot be increased owing to the position of the site. The National Battlefield's Commission have given the Government leave to erect a station on the battlefield at Quebec.

Electric Railways

Toronto's Municipal Railways

In addition to the municipal line recently placed in operation on Gerrard street east, by the municipality of the city of Toronto, there is at present under construction two sections of railway which will add about seven miles to their system. On St. Clair avenue the line is practically complete for operation from Yonge street west to the Northern Division of the G. T. R. line, a distance of about 3.2 miles. It is expected that operation of this line will commence inside of two months. On Danforth avenue the work is not so far advanced but it is expected that 3½ miles of line from Broadview to the eastern city limits will be in operation some time this fall.

The work on St. Clair avenue presents a number of interesting features, one of the most important of which was the widening of the street from the original 66 feet to 100 feet. Though this represented a big expense there is little doubt but that the added attractiveness of the avenue with the much greater space allowed for traffic will more than offset the additional capital expenditure.

The St. Clair avenue installation is shown in section in Fig. 1 herewith. It will be noted that the trolleys are suspended from a single pole placed in the centre of the roadway. Each trolley wire hangs 9 feet from the centre line and at a distance 18 feet 6 inches from road level. These poles are set 6 feet in the ground in concrete.

The gauge used on all the municipal lines is 4 ft. 10⅞ in. to correspond with the Toronto railway system. On the St. Clair line, as seen in Fig. 1, the devil strip is 7 feet wide. No concrete is used under the rails, the filling being gravel to the top of the ties and from there to the top of the rail 2-in. crushed stone. A 4-in. tile drain is placed, as shown, at the centre of the roadway with 3-in. tile at the sides. On each side of the tracks as far out as the inner curb of the roadway, for a distance of 4 ft. 9 in., the space will be sodded.

The roadway on each side of the tracks will be 18 ft. wide with a 4-in. crown. The composition will consist of a 6-in. concrete base, a 1-in. binder and a 2-in. asphalt surface. The concrete walk on either side is 5 ft. 6 in. in width, the sidewalk being placed 2 ft. from the curb and 7 ft. 6 in. from the outer street limits.

At street corners where loading and unloading takes place, the 4 ft. 9 in. grass boulevard will be replaced by cement running back from the corner some 55 or 60 feet.

Lorain section No. 335, 7-in. T-rail, 80 lb. to the yard has been installed on untreated cedar ties. The trolley wire is a No. 2/0 hard drawn round copper. The distributing cable is 500,000 c.m. W.P.T.B. Current will be supplied from the sub-station of the Toronto hydro-electric system on Macpherson avenue, where sufficient converter equipment will be installed to supply the necessary current at 550 volts d.c.

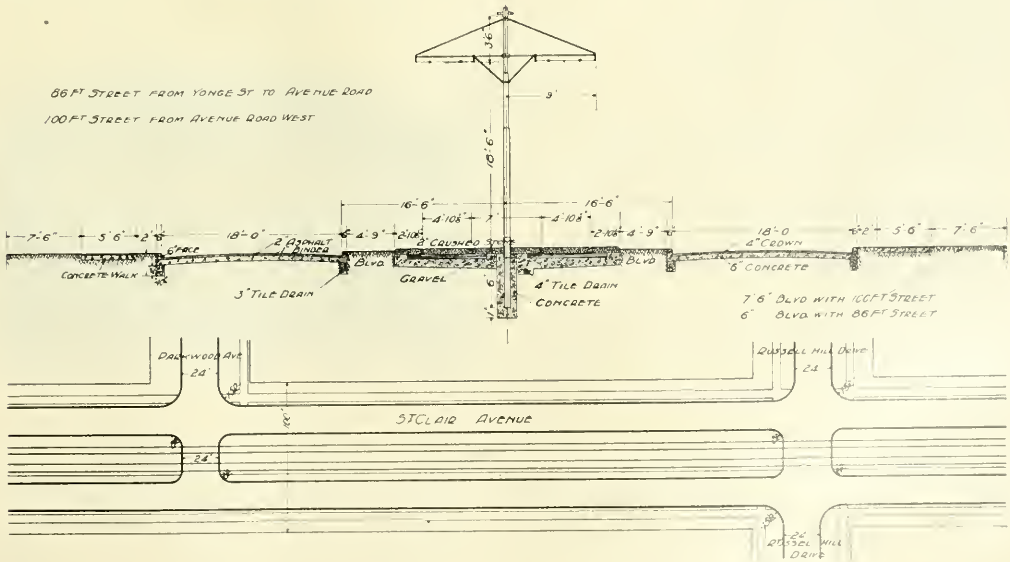


Fig. 1.—City of Toronto municipal street railway lines—Section of St. Clair avenue roadway.

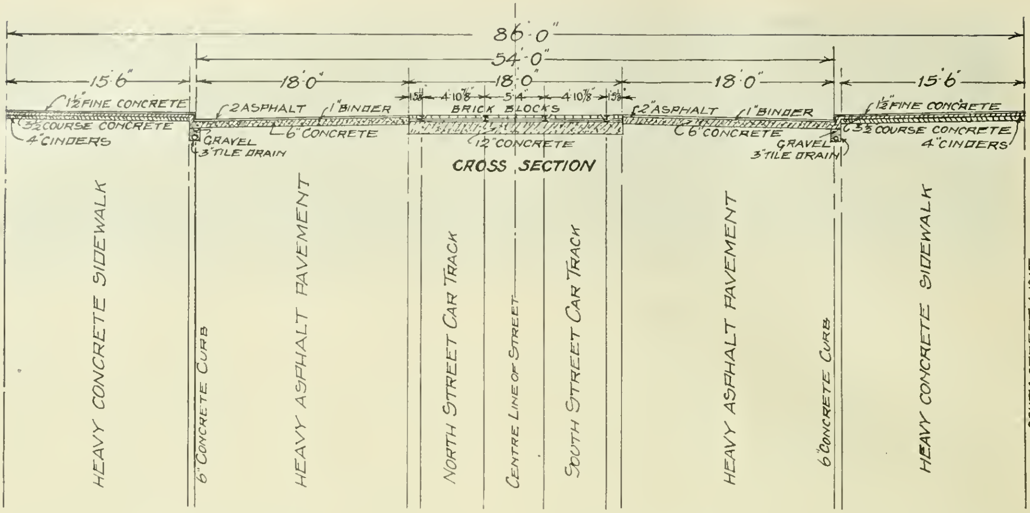


Fig. 2.—City of Toronto municipal street railway lines—Section of Danforth avenue roadway.

Danforth Avenue

The original 66 ft. road is being widened to 86, and a section of the installation is shown in Fig. 2. The 86 ft. is apportioned as follows: 18 feet for the tracks, 18 feet for each of the side roadways and 16 feet for the sidewalk and corresponding boulevard. The devil strip is 5 ft. 4 in. Lorain section No. 392, 7-in. girder rail is being installed, 90 lbs. to the yard, with tie plates and continuous rail joints. Cedar ties will be used on a concrete bed covered with wood paving. Power will be temporarily supplied from the sub-station of the Toronto hydro-electric system on Gerrard street east.

2/0 round copper trolley wire is used. The trolley wires are suspended from poles placed at the sides of the roadway, wooden poles already installed and belonging to the Toronto hydro-electric system being used on one side and iron poles on the other. These iron poles will carry city lamps for the illumination of the street. By this reciprocal arrangement the number of poles that must be installed on this street has been reduced by one-half.

Ten cars for each of these lines has been purchased from the Niles Car & Coach Company. The electrical equipment of each consists of four G.E.-80 motors and K-28 controllers with Westinghouse air-brakes, Baldwin trucks and Canada Iron Corporation chilled wheels. Each car is equipped for double end control. The cars will be centre aisle type, p.a.y.e., 44 ft. over buffers, and will be similar to those already in use on the Gerrard street line. When equipped for operation each car will weigh approximately 24½ tons. In all probability the parts will be brought to Toronto and the cars assembled here.

The work of installation of the municipal car system is in charge of the works department under Mr. R. C. Harris, commissioner. More closely connected with the work is Mr. C. W. Power, assistant engineer of railways and bridges. Mr. D. W. Harvey is in immediate charge of the construction work.

Montreal Tramways Roadbed Improvements

Some 1,200 men are being employed by the Montreal Tramways Company in re-laying tracks in different parts of the city, part of an extensive programme which will be carried out during the next few months. The old rails of 96-pounds weight are being replaced with rails of 116 pounds, the guard rails being increased to 132 pounds; these will be standard for the future. In certain sections special cedar ties are being laid down, the length being increased from seven to eight feet, while they are put two feet apart instead of 2 ft. 6 in. The roadbed has been greatly strengthened, with a view to resisting the frost. Eight inches of crushed stones are followed by two inches of stone dust as a bed for the ties; then comes six inches of concrete, the blocks being laid on this mass and grouted with cement, making a bed of 21 inches in depth.

New Cars for Moose Jaw

The Moose Jaw Electric Railway Company have recently placed in operation a number of new cars manufactured by the Ottawa Car Company. These cars have a seating capacity of 32. The length of the car body is 21 feet; the front vestibule 4 feet; rear vestibule 5 feet; length over

New car for Moose Jaw electric railway.

bumpers 31 feet; width of body outside 8 ft. 1¾ in.; inside 7 ft. 3½ in.; length of seat 34 in.; aisle width 20 ft.; cross seats covered with rattan. There are six cross seats on one side and five on the other with two longitudinal seats. The interior finish is red cherry with the ceiling of bird's-eye maple veneer, all in natural finish. The cars are equipped with Peter Smith heaters.

Permanent Track Construction

By Mr. C. B. Vorce,* Mem. A. S. C. E.

The B. C. Electric Railway Company, Limited, is a public service corporation operating the electric railway lines in Vancouver and adjacent municipalities on the mainland, together with the electric railway lines in Victoria, situated on Vancouver Island. The total length of railway operated is 303.54 miles, of which 148.77 miles are city lines and 154.77 miles are interurban lines. Of the city lines, 43.43 miles are double track and 61.91 miles are single track. 77.13 miles are of permanent construction on paved streets and 71.64 miles are standard steam railway construction on unpaved streets. The country in and around Vancouver is a rolling country and the maximum grade is 8.75 per cent. while in and around Victoria is flat giving no grade of more than 3 per cent. The population served by the railway on the mainland is about 200,000, while the railway in Victoria serves about 75,000 people. During 1912, 50,000,000 passengers were carried on the mainland and 12,000,000 in Victoria.

T rails are used exclusively on paved streets, 7 inch rails weighing 91 lbs., 87 lbs. and 70 lbs., depending on the amount of traffic. On unpaved streets and on the interurban lines the municipalities permanently pave the streets. The cost of this paving from curb to curb, together with concrete foundation is borne by city or municipality. Before the writer became connected with this railway company the permanent track work was let by contract to the contractor for the city paving. This method gave such poor results that the writer organized a construction department to enable the company to do the work themselves. The plant used in doing this work is as follows:—

One Model 40 Marion steam shovel.
One Model 20 Marion steam shovel.
One A1 Thew automatic steam shovel.
One A1 Thew automatic electric shovel.
One steam derrick with 60-foot boom.
One Brown hoist derrick car.

Two Koehring concrete mixers with 27 ft. delivery boom operated by gasoline.

Two Koehring concrete mixers with 30 ft. delivery boom operated by gasoline.

One Koehring concrete mixer with 30 ft. boom operated by steam.

One 3-ton Packard motor truck.

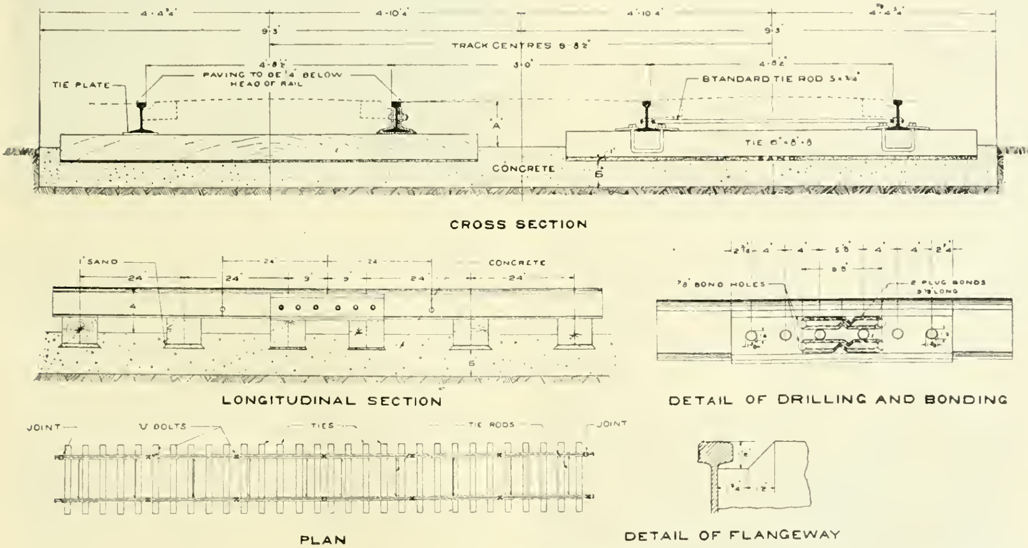


Fig. 1.—B. C. E. R. track construction.

where the standard steam road construction is used, the rails are either 70 lbs. or 60 lbs. A. S. C. E. section.

Previous to the writer's connection with the company the concrete girder type of construction was used on all permanent track work on paved streets, but owing to the breaking of the girder, due to the poor character of the foundation, the writer recommended and secured the adoption of the slab type of construction, Fig. 1, which gives a solid foundation on which to lay the track. The sand cushion was introduced between the concrete foundation and the tie to give the track as much resilience as possible, as the writer believes that the rigid type of construction resulting from the rail laid on steel ties embedded in concrete materially increases the cost of car maintenance.

Under our various franchises the company is compelled to replace the open or steam railway type of construction with a permanent form of construction whenever the city or

Five Duntley track drills.
Two Duntley track grinders.
Two rail planers.
Six centre dump wood ballast cars, 20 yds.
Four side dump wood ballast cars, 20 yds.
Five Koppel steel side dump cars, 15 yds.

Shunters are assigned to the construction department by the transportation department as required for construction work.

The method of construction is as follows:—Whenever the company is notified that the city or municipalities are ready to commence paving operations the railway company, whenever the width of the street will permit, build a temporary track on the side of the street with sufficient passing sidings to take care of the traffic. This leaves the centre of the street free and allows the building of the permanent double track without interruption. It might be added here that all paved streets are double tracked.

Grading operations are then started, the material being

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hauled by teams to a dumping place fixed by the city. In previous years all the material has been excavated by hand but during the coming season a steam shovel specially designed for shallow cutting in the track allowance will be used. It is hoped that this will materially reduce the cost of excavation, as common labor is paid from 25c to 37½c per hour. When the rough grading has been completed forms are set on each side of the track allowance, 18 ft. 6 in. wide, the top of the forms being the top of the concrete slab, and a gang of fine graders trim up the excavation to a grade 6 in. below the top of the forms. The concrete slab is then started. The gravel, sand and cement are delivered along side the track allowance, thus minimizing the distance travelled by the wheelbarrows, and the aggregate is delivered in place by a bucket travelling on the mixer booms. In this way labor, which is the most expensive item we have here, is reduced to a minimum.

After the slab has set for one day, the rails are laid on ties placed 2 feet centre to centre except at the joints where the spacing of the ties is governed by the length of the joint. The ties are then shimmed up to grade by placing small pieces of factory wood clippings at each end. A concrete mixer, Fig. 2, running on flanged wheels is then placed upon the track and the second operation, which brings the concrete up to the under side of the city's pavement foundation is commenced.

The remainder of the work in the track allowance, viz., paving together with the foundation for same, is paid for by the city or municipality.

So much delay and confusion has arisen on account of the railway company being unable to commence its work until the paving contractor had excavated to the city's subgrade in the track allowance, that the writer entered into an arrangement with the city authorities so that whenever possible the railway company enters into a contract with the city to do the grading and concreting in the track allowance at the same price as the city pays the paving contractor—this arrangement has so far worked very satisfactorily.

During the past few years the railway company has done a considerable amount of track reconstruction. In some cases we have been able to divert the traffic to other routes,

Fig. 2.—Concrete mixer on flanged wheels.

which has enabled us to reconstruct both tracks at the same time. In other places, however, we have built one temporary track and rebuilt one of the permanent tracks at a time, as it was necessary to have a double track to handle the traffic.

In this reconstruction work the principal difficulty encountered has been the removal of the concrete. Labor is so high that the manual method in use before the writer became connected with the company could not be used economically. Some mechanical method had to be adopted and the writer designed the "so-called" concrete breaker shown in Fig. 3. The dipper was taken off our electric shovel and pile driver leads were hung from the boom. In these leads ran a 2,600 lb. hammer with a wedge shaped base. The concrete was broken by dropping the hammer. The smaller pieces were loaded into skips which were dumped into wagons, and the larger pieces were handled by a steam derrick and loaded on to flat cars. This method was about one-half as costly as the old hand method.

This year we purchased an A1 Thew automatic shovel

Fig. 3.—Concrete breaker.

Fig. 4.—Shovel loading concrete on motor truck.

specially designed to dig in the track allowance, and in a piece of track reconstruction just finished we have not used the concrete breaker but have taken out the concrete with the shovel, Fig. 4. This has further reduced the cost of removing the concrete so that the cost per yard for removal is only about 65 per cent. of what it was last year.

At intersections solid manganese tongues, switches, mates and frogs are used in the special work and when the traffic is particularly heavy the curved rails are also of solid manganese.

The special work is installed without interrupting the traffic, the greater part of the work being done at night after traffic has stopped. The track allowance is first excavated to a point from 20 in. to 22 in. below the top of rail and new ties are put in on blocks so that when the special work is laid on them it will be to the established grade. As many pieces of the special work as it is possible to handle are bolted together and put in place with the derrick car. The intersection is then concreted, the concrete being brought up to within about one and one-half inches of the base of the rail in one operation. Short blocks, 20 in. long, 6 in. wide, and 4 in. deep, are then embedded in the concrete between each of the ties and the concrete is then allowed to set for ten days. Wedges are then inserted on top of these blocks and the special work brought to a firm bearing. The spikes are then drawn from the ties which are pounded down, thus taking up any settlement which may have occurred. Steel shims are inserted between the tie and base of rail and the concrete brought up to the base of rail. This method has proved very satisfactory and we have had no trouble with the special work, some of which has at least 3,000 cars per day passing over it.

Although common labor is paid from 25c to 37½c per hour and our cement costs us $2.60 per bbl. of 350 lbs. our

construction costs (1), compared with one of the largest cities in Eastern Canada (2), and one of the largest cities in the United States (3), are as follows:—

	1	2	3
Removing pavement	37%	58%	100%
Earth excavation	67%	68%	100%
Concrete excavation	37%	....	100%
Laying concrete	60%	100%	.....
Laying track	73%	....	100%
Concrete per yd.	68%	....	100%

The writer has been ably assisted in his work by H. J. Tippet, engineer maintenance of way, and by A. J. Kennedy, roadmaster.

Medicine Hat to Have Privately Owned Railway

The street railway by-law submitted to the electors of Medicine Hat, Alberta, on May 22, authorizing an agreement with the Montreal Engineering Company by which the latter should construct and operate an electric railway service in Medicine Hat, was carried by a large majority. It is understood that operations will be commenced immediately, and that a steam power plant will be installed using gas, supplied by the city at 5c per thousand cubic feet, under the boilers, or the city will furnish company electricity.

The main items of the franchise are contained in the following summary:—

Synopsis of Medicine Hat Franchise Agreement

The franchise is an exclusive one for twenty years within the present or extended boundaries of the city.

The city council can call for a line on any route when a population, excluding children under five years, is 400 per half-mile, the width of area to be included being 1/8 mile on each side of the street.

The council can call for extensions to any residential section if the line to this point passes through an area which averages 400 to the half-mile, as above.

Failure to extend the line after due notice renders the company liable to a fine of $100 per day.

The company pay taxes on land until the population of Medicine Hat reaches 40,000; from this number to 100,000 5 per cent. of gross earnings in lieu of taxes; above 100,000 10 per cent. of gross.

The city has complete control over the streets on which the railway is built and over the specifications according to which the line is constructed. Feed wires on streets where cars are not operating must be underground.

The company must buy gas from the city at 5c per thousand feet or electricity at 1c per kw.h.

Passenger cars operate between 6 a.m. and 12 mid-night. Tickets are 5c cash, 6 for 25c, 25 for $1.00; workmen's tickets, 8 for 25c; school children's, 10 for 25c. If the company decides to run night cars they may charge a 10c cash fare. Freight may also be moved between 12 midnight and 6 a.m., and at other times as arranged with Corporation.

The city may use company's poles to string municipal wires.

Interurban railways are allowed to enter the city and run over the company's lines, but it is necessary that the consent of the city be first obtained.

No local business can be done by an interurban railway.

The company maintains that portion of the street between the rails and 18 inches on each side. The rails must be 80 lb. weight.

Provision is made limiting the amount of street that can be broken up at any one time by the company to 2,000 feet.

The city has full control of the schedule and stopping places of cars.

Provision is made for the free transportation of municipal officers, such as policemen, firemen, meter-readers, etc., when in uniform.

The company flushes the streets along the lines of its railway, the city paying for the same at actual cost.

In case of dispute provision is made in the agreement for the appointment of a board of arbitrators, but there is to be no appeal outside of the province of Alberta.

If the city decides to take over the property of the company at the end of twenty years, the value of the plant fixed by arbitration plus 15 per cent. is to be paid for it. The franchise is not to be considered in this valuation.

The first section of the road is to consist of nine miles, this to be interpreted as meaning nine miles of street.

Mr. J. B. D'Aeth, formerly with the Stone & Webster corporation in the construction of the Saskatoon railway system, will be the resident engineer in Moose Jaw, and will be asisted by Mr. L. G. Mills, of the Montreal Engineering Company's staff. Mr. D'Aeth will be responsible to general manager R. O. Sweezy, who will be located at Montreal.

Montreal Tramway Congestion

Mr. G. Janin, chief engineer of the Montreal City Council, has submitted a report on the tramway congestion to the Board of Control. He has had under consideration various schemes submitted by Mr. D. McDonnell, Mr. J. P. Fox, and others, and states that immediate steps should be taken to procure increased facilities in almost every part of the city. An effort should be rather to eliminate some of the overlapping and inter-crossing of the cars belonging to the various routes in the cramped space of the downtown district. This can be done by stopping some of the routes just outside of the congested area, and whenever possible causing the cars to perform their turning operations by means of tracks which do not interfere with the actual movement of loaded cars. The recommendations include the elimination of all unnecessary stops, placing switchmen at every important junction point, teaching passengers to have their fare ready, the installation of larger and clearer signs on cars, the relief of congestion in the rear part of cars, the prohibition of the hauling of freight in day time, better supervision of traffic at junction points, doing away with delays at the central office, the prevention of "short-turning" of cars at the option of the conductor, and the installation of autobus lines to supplement the tramcars.

Canadian Street Railway Association

The convention of the Canadian Street Railway Association, which was this year held in Hamilton, resulted in the election of the following officers:—President, Patrick Dubee, Montreal; Vice-president, C. B. King, London; Secretary-treasurer, Acton Burrows, Toronto; Executive: James Anderson, Windsor; E. P. Coleman, Hamilton; James D. Fraser, Ottawa; H. M. Hopper, St. John, N.B.; Wilson Phillips, Winnipeg, and A. Eastman, Kingsville.

The Fredericton Street Railway Company are at present negotiating with English capital, which it is hoped to interest in the project, and it is likely that development work will be proceeded with within the course of a month or two. It is proposed to construct an electric railway along the chief thoroughfares of the city of Fredericton and also to build a line of railway across to St. Marys and Gibson, the complete circuit being about 5 miles. An extension of the line to Marysville is also under consideration. To operate the projected line it is proposed to employ the water power developed by the St. John River Hydro-electric Company, at Meductic Falls, 410 miles above Fredericton on the St. John River where there will be an initial development of 10,000 h.p.

Illumination

Street Illumination in Prince Albert, Sask.

Following the presentation of several petitions by property holders, the council of the municipality of Prince Albert, Saskatchewan, decided on June 24th, 1912, to substitute a five cluster tungsten light system for the old a.c. series arc lights in the principal streets, and a by-law to that effect was read twice in the council on that date. The by-law was subsequently advertised in the daily press of the city and no opposition developing the by-law was read a third time and passed on July 2nd. It was decided to put in 132 standard lights at a varying distance of 70 to 90 feet apart, this variation being necessitated by irregularities in the city survey plan. The City Commissioners, Mayor Morton, F. A. Creighton, C. O. Davidson, Ald. O. B. Manville, chairman of Light and Power Committee, and electrical superintendent R. Wright, selected a Roman Doric, No. 5 design Union Metal tungsten standard manufactured by the Union Metal Manufacturing Company, of Canton, O.

The following table indicates the location and number of the lamps installed to date:—

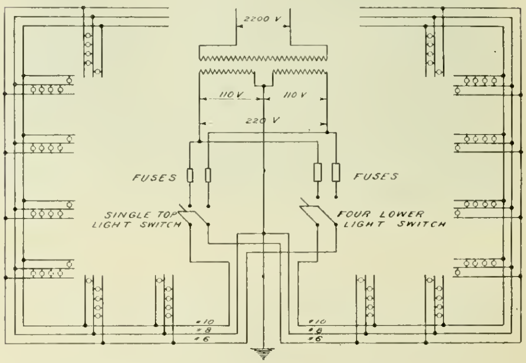
Centre ave., both sides, from River street to 15th St.,...	56
1st ave., both sides, River St. to 12th St.	20
10th St., both sides, from Centre Ave. to 1st Ave. W...	16
11th St., both sides, from Cent. Ave. to 1st Ave. W...	16
12th St., both sides, from Cent. Ave. to 1st Ave. W....	14
River St., South side, from Cent. Ave. to 1st Ave. W...	10

Erecting ornamental standards, Prince Albert.

At a total estimated cost of $16,800.

The tender of the above Company's standard, placed through their agents, the Canadian General Electric Company, was accepted. The Canadian General Electric Company also supplied the glassware, sockets and base switches, the total amount of the tender being $6,640 f.o.b. Prince Albert for 135 complete standards (without tungsten lamps). The glassware was manufactured by Gill Bros., of Steubensville, Ohio, the glass being their well-known Parian make. The top globes are 14 inches with 7-inch neck. The four lower globes are 12 inches with 6-inch neck. The lights used are 100 watt tungstens on the top and four 60-watt lights on the cluster.

Owing to the cement sidewalks being already laid where



Wiring diagram of Prince Albert distribution.

the standards were proposed to be erected, it was decided to use armored protected cable and lay same in a trench in the roadway gutter. The cable was laid 18 inches deep from the top of the sidewalk and 12 inches away from the curb. The order for the cable was given to the Canadian British Insulated Company, Limited, of Montreal. The cable is three conductor type, the size of the conductors being No. 6, No. 8, and No. 10 B. & S. gauge. The conductors are paper insulated, enclosed in lead sheath, protected by a double layer of flat steel tape, the steel being further protected by a treated jute covering. The trenching and laying of the cable was done by city workmen the cable jointing being done by men supplied by the cable company, the whole of the work being supervised by Mr. M. K. Davis, of the Canadian British Insulated Company's staff.

The cables are looped into a pothead placed in the base of each standard, connections being taken from the pothead to the inside wiring of the standard. The system used is 220 and 110 volt three wire, the four lower 60 watt lamps being connected between the No. 6 and No. 8, and the single 100 watt lamp being connected between the No. 8 and No. 10, the No. 8 wire acting as a partial neutral. The control is from seven individual boxes on transformer poles, connected so that a transformer is balanced when feeding two cables, one each way around a block, and so that one double pole switch controls the lower lights on both cables and another double pole switch controls the single light as per diagram shown.

Trench digging and the drilling of the granolithic side-

Main street of Prince Albert, Sask., showing ornamental five-light standards.

walk, the latter being done by a compressed air drilling outfit, was commenced on October 15 and completed on November 8th, 11,020 feet of cable being laid, the linear length of trenches being 9,752 feet. The cost of digging, laying cable and filling in was 5.3c per linear foot, the force employed being an average of nine laborers for 21 days at an average rate of 27½c per hour. This was 5c per hour more than given the ordinary city laborer, but given on the understanding that the men were to be rushed in order to finish before the ground froze up.

The price of the cable was $4,518; the cost of cable jointing and supervision which was done on a cost plus 15 per cent. basis, was $1,003.61

The bases were distributed as soon as they arrived and placed over the potheads; English-speaking laborers were employed to level and bolt them to the sidewalk. Owing to the varying thickness of the concrete sidewalk, the bolts were cut to fit on the ground and the bases were levelled and tightened down. The heads were wired under the cover of a shed, before distribution, three men completing the erection with the aid of prepared trestles, see figure. All this work was done under the supervision of the Electric Light Department. The total cost of installation was $15,659.14 or an average of $118 per standard.

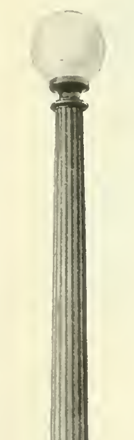
General satisfaction has been expressed at the appearance of the city, Central Avenue being spoken of as "The Great White Way," and some very favorable comparisons have been made by outsiders of the appearance, proportion and grace of the standards as compared with other cities having similar systems. It has been resolved to extend the work by another hundred lights this year and to gradually extend the system to take in the entire business portion of the city.

At the present time the lights are turned on and off by hand, the top light being allowed to burn all night, the four lower cluster lights till 12 p.m. It is proposed to control the top lights from the power station by solenoid operated switches placed in a series arc light circuit. The switch controlling the four lower cluster lights will still be turned off and on by hand. The department have a patrol man on duty from dusk to 12 p.m. and it has been decided to add the work of looking after the standards to his other duties.

Illuminating Engineering Society

At a recent meeting of the Convention Committee of the Illuminating Engineering Society it was decided to hold their next annual convention in Pittsburgh during the week ending September 22. It is expected that several hundred engineers from all parts of the country interested in lighting in its various forms will be present and the program, details of which have not as yet been completed, will consist, in addition to the technical sessions, of a reception and dance, several excursion trips and visits to various industries in Pittsburgh. Mr. J. C. McQuiston, of the Westinghouse company, is chairman of the publicity committee, and will make all arrangements for advertising the convention.

New Luxolabra Installations



During the first week in June lights were turned on in some 150 standards in the town of Galt, including the installations on Brant road, Lansdowne avenue, Wentworth avenue, Aberdeen avenue, and west Main street. These are one light Jandus Luxolabra, as shown in the accompanying reproduction. The equipment was supplied by the R. E. T. Pringle Company.

Further extensions in Galt are being made on Ainslie street between Colborne and Concession streets, on both sides of the road. These will be three-light Luxolabra. A petition is also being circulated and as soon as it is sufficiently signed the city council expect to begin the erection of lights on Main street. This installation will represent 75 or 80 standards, each carrying, probably, five lights.

A contract has recently been closed also, within the last few days with the town of Brockville. The Brockville installation will consist of fifty 5-light and twenty 3-light Luxolabra. This latter installation will be carried on under the supervision of Mr. E. J. Philip, formerly of Berlin, but now superintendent of the electrical department of the municipality of the town of Brockville. Among other installations which have been put in by this company, or at present under way, may be mentioned a 60 standard 5-light installation just completed in Kenora. The city of Winnipeg has also just completed the installation of 100 inverted arc Luxolabra, in which the C. G. E. magnetite lamp has been installed. The town of Smiths Falls are also considering the matter of ornamental lighting and expect to install this type.

Focusing Type Flame Arc Lamp

A new type of flame lamp known as the focusing type has recently been placed on the market by the Adams-Bagnall Electric Company, some illustrations of which we reproduce herewith. In this type, using a carbon ⅞ in. in diameter and 14 in. long, a life of from 100 to 120 hours is obtained.

The composition of the electrodes of all carbon flame lamps is more or less uniform. The electrodes consist of cored carbons, the core being filled with a mixture of finely ground carbon, generally in the form of lamp-black, with some salt. Originally common salt was used which gave a very yellow flame. Later calcium flouride was the salt more generally mixed with the lamp-black, these electrodes producing a reddish orange light of great intensity. More recent developments have shown that strontium and barium salts, and especially the latter, give very pleasing illumination results, though at the expense of efficiency. No electrodes have yet proven as efficient as those in which the core contains calcium flouride. The use of barium results in a much whiter light.

In the new focusing type flame lamp the composition has been so changed that it is claimed a mellower warmer and more cheerful effect is produced. The regenerative tubes, a feature of the former type of this company's lamp have been done away with and the condensing chamber is placed entirely above the arc. The gases in consumption circulate through this condenser in much the same manner

Fig. 1.

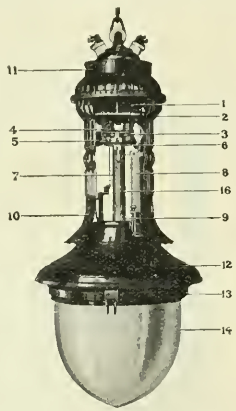


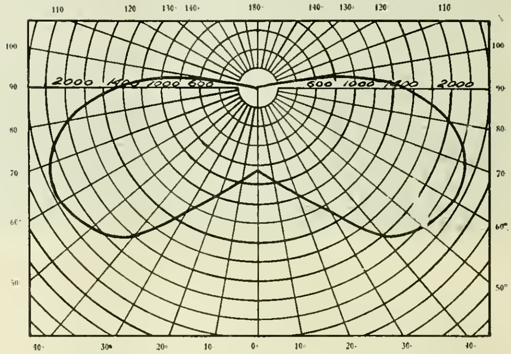
Fig. 2.

as they formerly did through the side tubes. The upper and lower electrodes are both movable, so that the arc is always held in the same position. It is claimed that though the cost of flame carbons per trim is higher than metallic electrodes for luminous arc lamps, the extra efficiency of the carbon flame type reduces the operating cost to such an extent that over a year of say 4,000 hours, the total operating cost of the two lamps is approximately the same.

The new focusing type lamp is obtainable in different forms for operation with either alternating or direct current, series or multiple. The a.c. current lamp only operates satisfactorily on frequencies above 50 cycles and uses from 7.5 to 10 amp. at 100 to 110 volts. The standard direct current lamp operates at 6.6 amp. The different types of lamp are shown in Figs. 1 and 2.

In Fig. 2 the mechanism can be understood by reference to the indices as follows:—(1) series solenoids; (2) shunt solenoids, opposite series; (3) walking beam; (4) series solenoid armature; (5) adjuster weight on walking beam; (6) series cutout; (7) slotted center tube; (8) starting resistance; (9) air pot; (10) copper case, removable panels; (11) ventilated top; (12) condenser; (13) outer globe band, (14) outer globe. An important feature of these lamps is that they operate on both alternating and direct current.

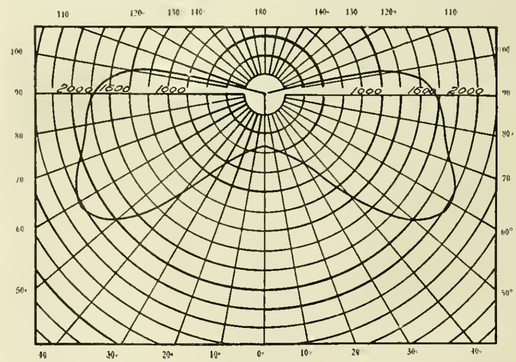
The operation of the lamp may be judged from the following typical electrical data referring to the series, alternating current, 7½ amp. type—terminal volts 87; terminal watts



Dist. curve of 6.5 amp. d.c. multiple type.

450; power factor 75; life of trim 110 hours; for the lower electrode the stub of the upper is used; life of inner globe 1,000 hours; life of outer globe 2,000 hours; efficiency of the system 96½ per cent.; cost of lamp $40; cost of standard equipment per lamp $62.20; cost of electrodes 17c; cost of inner globes 50c; outer globes $1.25; trimming inspection per trim 5c.

It is calculated that the cost of the maintenance of one of these lamps per year on a 4,000 hour basis amounts to $14.64 made up as follows:—cost of upper electrodes, $6.29; inner globes, $2; outer globes, $2.50; trimming and inspection, $1.85; repairs, $2. The fixed charges are placed at $18.39 made up as follows:—interest on investment, $6.13; depreciation, $10.22; taxes and insurance, $2.04. The total operating cost of a year of 4,000 hours therefore, amounts to



Dist. curve of 7.5 amp. a.c. series type.

$51.67, made up as follows:—energy cost at 1c per kw. hour, $18.64; maintenance, $14.64; fixed charges, $18.39; total, $51.67.

The mean lower hemispherical candle power of this lamp is 1800, so that the cost per candle power per year is 2.87c. With the energy cost at any amount greater or less than 1c per kw. hour, the fixed and maintenance charges of $18.39 and $14.64 will not vary and the total will be just so much greater or less than the $51.67 given above.

Indirect Illumination in the Hub Clothing Store

Written from the viewpoint of a member of the firm who are proprietors of this store, the largest in the world handling men's furnishings

The retailing of merchandise at the present time is an entirely different proposition to what it was a few years ago. The modern mercantile establishment must not only have a complete and varied assortment of goods to offer, but it must give value in the fullest sense of the word. The equipment of the establishment must, therefore, develop in the highest possible degree a proper system of merchandise display so as to turn over the stock a sufficient number of times to make a profit. To this end merchandise must be properly displayed both in the windows and in the interior of the store; at the same time, every comfort and convenience must be provided for the customer. In addition to all this, sanitary and exhilarating surroundings promote the greatest efficiency and co-operation on the part of the working force.

Having in mind the aforementioned essentials and a full realization of the desirability of a change in lighting equipment from that which in the past had proven so unsatisfactory, we made a very exhaustive investigation and ran competitive tests in order to determine the most desirable method of general illumination for our new store recently erected at the north east corner of State street and Jackson boulevard, Chicago. Approaching the lighting question solely from the view point of the merchant, the following essentials were taken into consideration:—selling value; advertising value; impression of the passer-by; first impression upon entering; equipment design; cost; current consumption; cost of maintenance; depreciation and appearance of goods. The decision to install the indirect illumination was based upon the following conclusions, which decision seems to be justified.

Selling Value—The attention is in no way detracted from the merchandise. By cutting down shadows, the false values in garments have been reduced.

Indirect illumination in Hub clothing store.

Advertising Value—Indirect illumination gives the whole store the appearance of an immense show window, brilliantly illuminated with no exposed lights in view. After sun down the attention of countless numbers of people passing would, in consequence, be attracted to the store in a startling manner. They would receive a mental impression as to the location of the store that many times the same cost expended in any other way would not secure. Heretofore it has been impossible to attract attention above the ground floor but indirect illumination positively does this. Ordinary lighting appliances with numerous light sources or bright bowls seen from the street make an unattractive appearance and, if noticed, make one think of the fixtures instead of the store.

First Impressions—The first impression on one entering a store is of great importance. If illuminated with a general diffused light with not one exposed light unit inside, one can see clearly the whole interior at a glance as he enters. Signs, price cards, merchandise on display and departments, as well as individuals can be distinguished readily. The ceiling has the appearance of being higher than it actually is, the architectural lines being emphasized and not destroyed. With direct light or bright bowls the effect is undoubtedly the opposite. This is especially true of bowls of artistic design brilliantly illuminated where one's attention would be immediately attracted to the fixture. This is undesirable unless such goods are on sale.

Indirect illumination, sporting section, Hub clothing store.

Design—With indirect illumination specially designed bowls can be secured to harmonize with the interior, both in lines and color, and form part of the general scheme of decoration. This seems a very desirable feature and in marked contrast to semi-direct bowls which can be secured only in stock design.

Cost—In comparing the cost of specially designed indirect lighting fixtures it was found that these can be had at no greater cost than direct lighting fixtures. This, because the plastic material used in the bowls is less expensive than metal or glass used in direct or other classes of lighting equipment. Such fixtures, while not obtrusive, and which seem part of the general scheme, have an appearance of much greater cost than is actually the case.

Current consumption—The investigation showed that current consumption cost would be only slightly, if any, increased over satisfactory direct lighting. While the operating cost of all departments is of serious import the desirable results secured would make even an excess cost not of as great moment as it might at first seem. A slight increase in the efficiency of the employees under better working conditions of any kind will many times greatly offset the slight additional cost of operation.

Cost of maintenance—Any class of fixtures must of necessity be kept in repair and cleaned. By a systematic inspection and cleaning of indirect lighting fixtures our conclusions are that it is not more expensive to clean indirect lighting fixtures containing one-piece mirrored glass interiors, than translucent bowls or direct lighting fixtures.

We were led to believe by the actual experience of other institutions that this expense would be even less.

Depreciation—With any lighting system it would seem that the only depreciation is in the lamps. It is well recognized that the filament of tungsten lamps when encased in a reflector or a fixture that does not allow free ventilation rapidly deteriorates. By the use of inverted reflectors it would seem that the heat from the lamps would readily escape and keep their temperature down to a minimum.

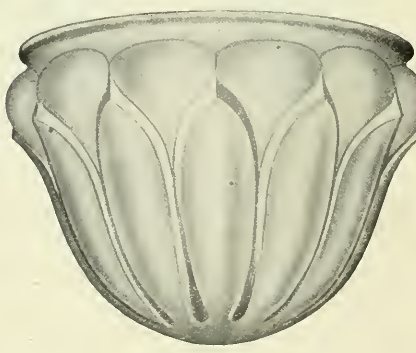
Besides the above mentioned advantages of indirect illumination we find the following decided advantages: (a) The general diffusion of light throughout the store enables each employee to work in a very efficient manner in the selection of goods from shelving, cases, boxes, etc. (b) The absence of dark corners and recesses so common with direct lighting gives the impression of a clean and hygienic condition. (c) The absence of the brilliant exposed lights unquestionably conserves the nervous energy of each employee, eliminates head aches and is very desirable from a humanitarian point of view. (d) Fewer mistakes are made under these favorable lighting conditions. Work in general is greatly facilitated.

Many otherwise perfectly arranged and equipped stores of to-day are doing untold harm to their own working force and to the public they have, at great expense, attracted to their place, by almost criminally careless methods of lighting. There is no feature about our establishment that is attracting more favorable comment from our customers or from our employees than our lighting installation.

Delica White Glassware

The production herewith represents a type of pure white glassware manufactured by the Pittsburgh Lamp, Brass & Glass Company, and known as "Delica White." As its name implies this is a delicate white production of fine texture which is secured by the use of a very fine grade of plate glass. It is further claimed for this ware that it is distinguished no less for its dignified beauty than for its remarkable illuminating efficiency.

It will be noted that the design is after the exquisite

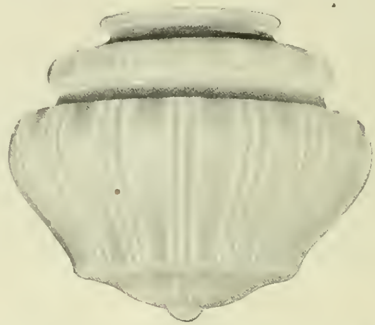


contour of the pond lily. To more nearly reproduce the lily effect this company manufacture certain of their designs with colored leaves and it is said that with gas or direct electric lighting this lily tint is exceedingly beautiful. The company have recently issued catalogues illustrating and describing the different lines of glassware they manufacture.

W. E. Skinner, Limited, Consulting Engineers, have been engaged by the Town of Wolseley, Sask., to place a valuation on the plant of the Central Light & Power Company of that place, with a view to the town purchasing the plant.

The Jefferson Glass Company

The accompanying illustrations of handsome glassware are typical of the class of product being turned out by the Jefferson Glass Company, Limited, Toronto, Canada. This



company has just issued a bulletin known as "Moonstone Bulletin No. 1" in which they describe with profuse illustrations, a number of their designs in illuminating glassware. The Moonstone is a semi-translucent glass of unusual

efficiency and billiancy. It absorbs very little light, is a perfect diffuser, and gives a most artistic effect and high quality of illumination. This company is, we believe, the only one manufacturing illuminating glassware in Canada.

Strassburg Light Plant

The corporation of the town of Strassburg, Sask., have recently placed a contract for one 50 B.h.p. Ruston-Proctor gas producer and engine with the British Canadian Engineering Company, Limited, Winnipeg. The electrical equipment, including a 37½ kv.a. generator, 3-phase, 60-cycle, 2300 volts, together with exciter, switchboard, pole line and all accessories, also tungsten street lighting equipment, was awarded to the Canadian General Electric Company. The plant is to be in operation in September of the present year. The total cost of the above equipment exclusive of power house is $9,850.

The North Coast Electric Company, Limited, announce that they have taken over the business of the B. C. Holst & Company, and have established warehouses at No. 350 Water street, Vancouver, where they will carry a complete stock of apparatus and supplies. Though not completely stocked as yet, material is arriving daily and the firm report that they are in a position to fill orders promptly.

The Dealer and Contractor

New "Midget" Meters

The Keystone Electrical Instrument Company of Phila., Pa., has been perfecting for the past year a midget ammeter and voltmeter 3 in. in diameter, of the highest grade for use on switchboards, automobile dashboards, and for portable service where a small instrument is particularly desirable. In bringing out this instrument this company has endeavored to reduce the number of parts required in the standard d'Arsonval system to a minimum. It is a well known fact that the d'Arsonval principle is the most accurate for direct current measurements, and in order to reduce the cost of these small instruments, and at the same time produce a high grade accurate instrument much study has been given to this feature.

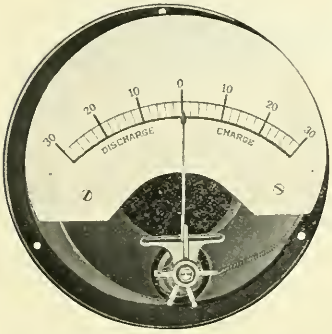


Fig. 1—Ammeter, cover removed.

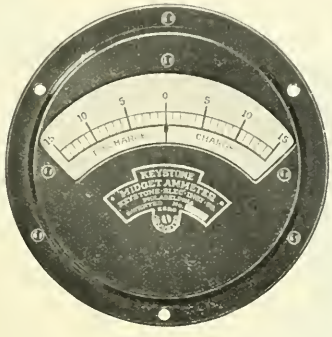


Fig. 2—Flush type.

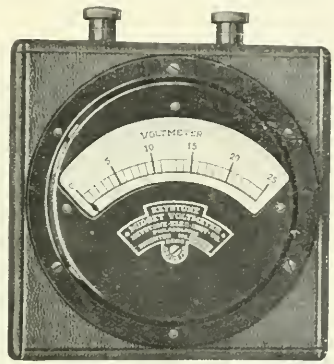


Fig. 3—Portable type.

Fig. 1 shows the board type ammeter, cover removed. The simplicity of construction will be evident at a glance. A tungsten steel magnet of unusually large size is used so that permanency can be secured, and also to increase the dead-beat operation of the instrument. This magnet has no pole pieces, the poles being accurately ground. This does away with the magnetic joint between the magnet and the pole pieces, and also increases the magnetic strength. The bases are of moulded material to insulate the studs carrying the current through the switchboard or dashboard, and this material is also used so that the magnetic strength may be unaffected. To obtain the greatest strength from the magnets the covers are also formed of brass instead of iron. All holes in the covers and bases are square so that there is no possibility of turning of any of the parts when tightened up. The aluminium coil form, seven thousandths of an inch in thickness, on which the fine enameled wire is wound, swings in sapphire jewels between the poles of the magnet. The pointer is of aluminium tubing twelve thousandths of an inch in outside diameter and with a wall one-thousandth of an inch thick, and the whole moving element weighs only slightly over one-tenth of a gram, or the weight of one common pin. With a moving element so exceedingly light as this the instrument is absolutely dead beat in operation, and the pointer does not oscillate, even if the instrument is subjected to severe vibration. This exceedingly light moving element also has the advantage that there is practically no weight whatsoever on the pivots and bearings, assuring long life for the instrument. The scale is white enameled on brass except where black scales with white letters are preferred. Each instrument is equipped with a zero adjusting device by means of which the pointer can be readjusted to zero at any time from the outside of the case.

In Fig. 3 is shown the flush type instrument 3¼ in. outside diameter, and in Fig. 4 the portable type, the instruments having a scale 2¼ in. long as shown in Fig. 5 which affords a clear legible scale for easy reading.

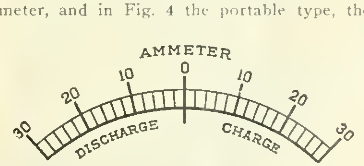


Fig. 4—Scale, full size.

On account of the design of the instrument with such a small number of parts, and on account of the large quantities in which it is possible to manufacture them this high grade instrument is being put on the market at a low cost.

This instrument is of particularly attractive appearance, being furnished in either dull rubber finish or full nickel plate, and it will prove of particular interest where a high grade instrument of small size is desired with an accuracy which can be relied upon.

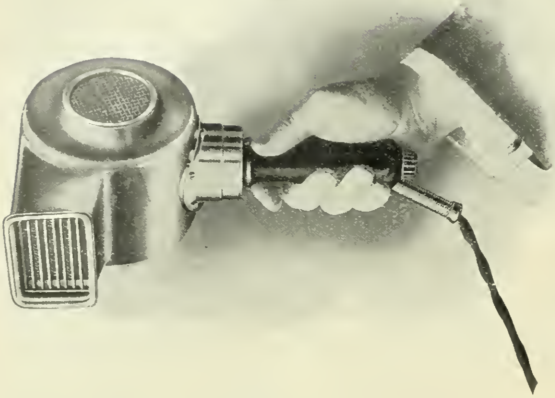


Fig. 1.

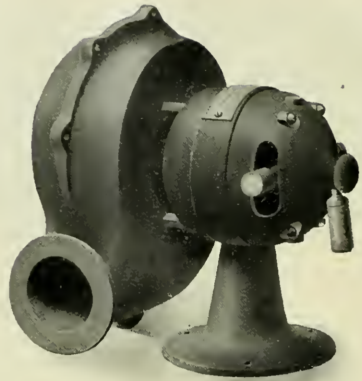


Fig. 2.

Small Motor Applications

The cuts shown herewith illustrate a few of the numerous articles manufactured by the Hamilton-Beach Manufacturing Company, for whom R. E. T. Pringle holds the Canadian agency. Fig. No. 1 represents a motor-driven hair dryer. The motor is of the universal type operating on either d.c. or a.c. current. The dryer will supply either hot or cold air as required, the hot blast being obtained by a simple turn of the switch which cuts in a heating coil over

Fig. 3.

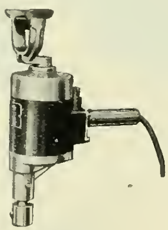


Fig. 5.

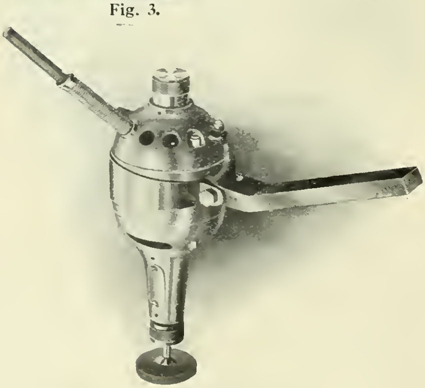


Fig. 4

which the air must pass being forced by a small enclosed fan. Fig No. 2 represents a small centrifugal blower operated by a 1/20 h.p. motor. This motor is also of the universal type and in addition to operating the blower may be used for any household general utility purpose. Fig. 3 illustrates this company's latest type of solid cast aluminium vibrator, also equipped with universal motor which can be operated off any live circuit of the proper voltage. Fig. No. 4 shows their latest type of bench and tool-post grinder. This grinder, we understand, has met with exceptional favor among electrical contractors, as it may be used to advantage for sharpening augers and drills, for commutator grinding, for grinding small castings, etc. Fig. 5 illustrates the latest type of ¼ in. universal Van Dorn and Dutton portable electric drill also handled by this Canadian firm.

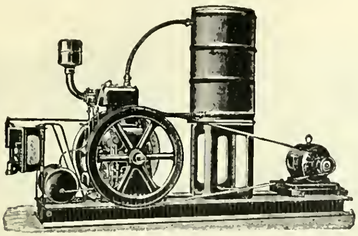
Good Electrical Exhibit

As illustrating the possible scope of the modern electrical display, the following exhibit by one of the largest manufacturing companies and its subsidiaries at the Chicago Convention of the N.E.L.A. is interesting.

The exhibit consisted of several general utility motors and those for general household, office and store use. A complete line of heating apparatus for domestic and industrial uses, including toaster stoves, disc stoves, irons, coffee percolators, frying pans, chafing dishes, sterilizers, luminous radiators, air heaters, saute pans, heating pads, milk warmers, tea samovars, tailors' irons, soldering irons, automobile tire vulcanizers, solder pots, liquid heaters, glue pots and chocolate warmers. Fan motors of all kinds showing new and remarkably light and efficient drawn steel frame fans for use on a.c. and d.c. circuits; 8-in., 12-in. and 16-in. desk and bracket, and oscillating types, also different styles of exhaust fans. Ozonizers for purifying the air, one of black and one of enamel finish. A rack containing a display of insulating materials. A solder which only requires a match. Quartz lamps and arc lamps of the flame carbon type for operation on a.c. and d.c. circuits, multiple and series. A battery charging mercury rectifier outfit with a time switch for ending the charge at any pre-determined time. A mechanical (vibrating) rectifier for charging ignition batteries. A bell ringing transformer and distributing transformers of 5 and 7½ kv.a. capacity with fuse blocks; a switchboard panel with a complete equipment. Meters of all kinds, indicating, watthour, graphic and precision. Carbon circuit breakers, from 12½ amperes to 6,000 amperes capacity and oil breakers as high as 44,000 volts. Condenser type terminals, arresters, lamps, etc.

Small Electric Light Plants

The need of small electric light plants for supplying light and a limited amount of power to isolated buildings, such as country hotels, country homes or small villages, has long been recognized, but it has beyn difficult to supply a unit of the necessary small capacity at a price which would bring it within the reach of the average customer. Further difficulty has been met in the operation of the plant, the limited capacity not justifying the employment of a skilled engineer. A solution of this difficulty is now claimed by the R. A. Lister Company, who manufacture and install lighting equipments varying in capacity from .5 kilowatts to 6 kilowatts, operating at 60 volts with a speed of 400 to 500. The smaller units consist of a gasoline engine belt connected to the generator, but the larger units are direct connected.



Small isolated plant.

In connection with the plant there is also a storage battery which floats on the line in parallel with the lighting installation, and so is always fully charged. This battery is used exclusively for lighting or small power requirements at off peak hours, as for example, during the night, when only one or two lamps may be required. It is also used for starting the engine which is done by using the generator as a motor until such time as the engine comes up to speed.

The engine starts and stops automatically as the lights are turned on or off. This means that if more lamps are turned on than the battery is able to carry, the current taken from the battery is sufficient to operate the motor and start the gas engine running. The reverse is also the case when the lights are gradually turned out. Such an installation should be of the greatest value to small towns, country homes, hotels, country clubs, churches, etc. That this is being found the case is evidenced by the fact that between 400 and 500 of these engine-generator equipments are at present operating in Great Britain, and that, though this equipment has been on the Canadian market less than twelve months, there are already between 30 and 40 satisfactory installations at different points in Canada. The illustration is typical of one of the small units. The large tank represents a water cooling arrangement, the gasoline tank being shown to the left of the figure.

Canadian Allis-Chalmers, Limited

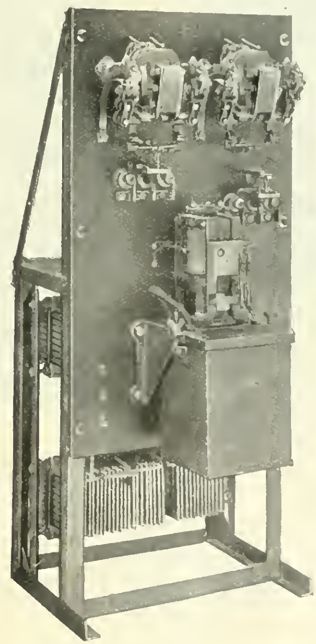
The Canadian General Electric Company, Limited, who own and control, as subsidiary companies, the Canada Foundry Company, Limited, and the more recently acquired Canadian Allis-Chalmers, Limited, have decided to consolidate the selling organizations of the two latter companies, dropping the name "Canada Foundry Company, Limited," and conducting the selling organizations of both companies under the name of "Canadian Allis-Chalmers, Limited."

This policy has been adopted because the name Canada Foundry Company does not appropriately cover the wide range of mechanical apparatus manufactured by that company, whereas the name Allis-Chalmers is synonymous with a very wide range of mechanical appliances and engineering works of magnitude, particularly in the manufacture of Corliss engines, water wheels, saw mill machinery, mining machinery, cement machinery, flour mill machinery, gas engines, etc., and these lines will naturally be complementary to the products of the Canada Foundry, such as steam locomotives, hydraulic machinery, pumping machinery, structural steel work, etc.

Hereafter all sales of electrical apparatus and supplies will be in the name of the Canadian General Electric Company, Limited, and all general engineering contracts and sales of mechanical appliances in the name of Canadian Allis-Chalmers, Limited.

Automatic Controllers For High Voltage Motors

Motors connected directly to 2200 to 1100 volt systems are now coming into general use in large plants, for waterworks service, etc. At this high voltage it is especially desirable to provide automatic starting apparatus. For this purpose the Cutler-Hammer Manufacturing Company of Milwaukee, has designed a new line of high tension automatic control panels. One type is designed for use with motors driving reciprocating pumps, air compressors or other machines which must be started under full load conditions, and which require a starting torque equal to or in excess of the normal full load torque of the motor. The other line, having the same appearance as that shown in the accompanying illustration, is designed for use with motors driving centrifugal pumps, or machines of similar load characteristics starting under light load conditions. The acceleration is controlled by resistance in each of the three phases of the rotor which is cut out step by step by double-pole magnetic switches under the control of current relays. By adjustment of the relays the starting current can be set at a predetermined value and the motor accelerated in the shortest time consistent with this current. An oil-immersed sole

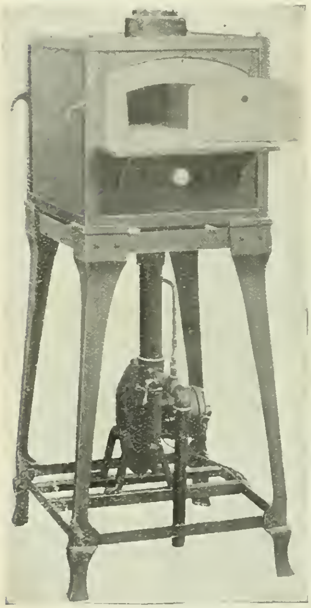


Automatic starting panel for high voltage motors.

noid-operated three-pole switch is also mounted on the panel which controls the high tension motor primary circuit. Where used on water systems, air or vacuum systems, suitable accessories such as float switch, gauge and diaphragm type pressure regulators and vacuum regulators are available.

Motor-Driven Blowers for Gas Furnaces

An improvement has recently been made in gas furnaces by forcing the air into the gas by means of a motor driven blower instead of merely allowing the air to flow in through valves as with the familiar Bunsen burner and gas stove. This forced draught permits a much higher heat, thereby increasing the efficiency of the furnace, extending the range of work it can handle, and making its production more rapid. It is claimed, for example, that a temperature of 2,500° Fahrenheit can be obtained with an air blast furnace whereas 1,800° is about the maximum for a similar furnace without the blast. This principle has been applied to furnaces for many lines of industry, such as candy furnaces, rivet heaters, muffle furnaces, etc. The illustration herewith is manufactured by the Improved Appliance Company, Brooklyn, N.Y., Westinghouse motors being used for driving the blowers.



Small motor application.

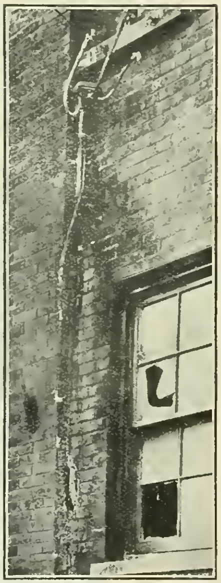


Fig. 1.

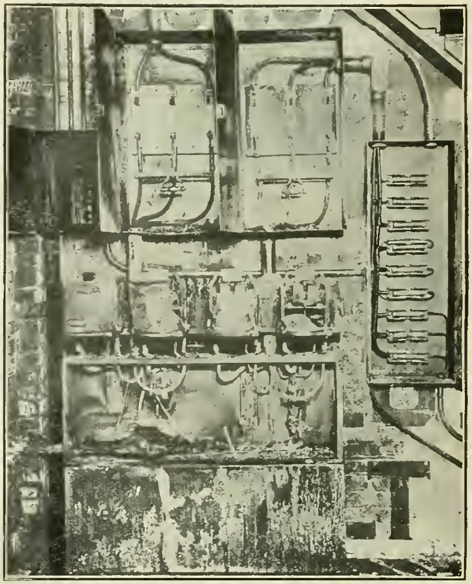


Fig. 2

Herbert Morris Crane & Hoist Company

A Dominion charter has recently been granted to The Herbert Morris Crane & Hoist Company, Limited, Peter St., Toronto. The new company will continue the Canadian business of the well-known English company, Herbert Morris Limited. We understand that the formation of a separate Canadian company was made necessary by the rapidly growing demand for Morris lifting and shifting machinery, and that the new concern will manufacture Morris products in Toronto. Herbert Morris, the president of the English company, will also be president of the new Canadian company, and he will be supported by a strong board of directors.

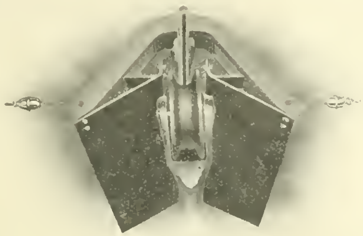
Efficient Service Protection

The best practice in electrical installation has come to look on proper protection from lightning or other disturbances as the best possible kind of insurance, not only against fire, but also against breaks in the continuity of service which are often disastrous in an establishment of large dimensions. The accompanying reproductions are typical of the results where proper protection has not been installed. Fig 1 shows a burnout in a service conduit running outside a factory, and Fig. 2 shows, indistinctly, the trouble caused in the cut-out cabinet inside the same building. This accident was the cause of a big delay in the work of the factory, meaning loss to the employees, manufacturer and consumer alike. The solution of such difficulties is a proper protection placed on the service wires outside the building. The Crouse-Hinds Company of Canada manufacture what is known as type F. F. condulet to meet this particular requirement. This is a weather-proof cast iron fuse box of special design which has the endorsement of the National Board of Fire Underwriters. This company claim that the above burnout could not possibly have happened if their type F. F. condulet had been installed. It is better by a small expenditure to prevent costly interruptions in the power supply than to incur a much greater expenditure by an accident.

Under the reorganization of the business of Mr. W. N. Dietrich, electrical and mechanical engineer, Read Building, Montreal, the scope of the undertaking has been enlarged. The company is known as Dietrich, Limited, and undertakes conduit installations, transmission lines and power plants, and heating. The president is Mr. W. N. Dietrich, who was formerly electrical engineer for the C. P. R.'s entire system, while the vice-president is Mr. G. E. Templeman, previously superintendent of construction in the engineering department of Allis-Chalmers-Bullock, Limited. The company are now carrying out some extensive electrical work in the provinces of Quebec and Ontario.

Automatic Trolley Guard

The automatic trolley guard illustrated herewith has recently been added to the line of equipment sold by the Electric Service Supplies Company. The guard is placed over the trolley wire usually at cross-overs intersecting steam and electric lines to automatically replace the pole when it leaves the wire. In doing this, it eliminates the danger of cars being stalled directly in the path of an approaching steam train. It is claimed by the manufacturer of this trolley guard that it will positively keep the pole on the wire, and that in a case where the pole is held down by the rope being caught, it is only necessary to release the rope and let the automatic guard immediately replace the pole. This guard not only assures a continual supply of current to cars passing through danger zones, but finds effective use on railways operating through tunnels, under grade crossings, bridges, dark sheds or at any point where it would be difficult to replace the pole on account of darkness or other objections. The simplicity of construction and the ease of installing the automatic trolley guard can readily be seen in the accompanying illustration. It consists principally of two aluminium coated steel sheets which are held in place by pressed steel yokes or hangers. These hangers are adaptable to any standard type of trolley car. Its simplicity does away with all projections or obstructions which could in any way prove a hindrance in the path of the trolley wheel and allows a free vent for gases from passing locomotives. It is also designed to eliminate the possibility of choking up from any combination of ice, dirt or soot. All the metals used in the construction of this trolley guard are impervious to the action of all elements with which they come in contact.



Guard in operation

Method of suspending automatic trolley guard.

Roper, Clarke & Company

Messrs. Roper, Clarke & Company, manufacturers agents, Montreal, recently received an order from the city of Regina for a 1200 kw. Peebles motor converter. This is said to be the largest machine of this kind in Canada. The same company have recently secured from the Garth Company of Montreal, orders for 20 a.c. motors varying in sizes from 2 to 24 h.p.; these are for installation in the Montreal high schools. Orders have also been received for several motors for the Art Association galleries, the new Royal Trust Building, and several other of the Montreal schools. Roper, Clarke & Company are distributing two pamphlets Nos. 16 B and 21B, describing d.c. motors and generators and a.c. motors. These pamphlets draw particular attention to the manner of construction of the rotors of the a.c. motors, particularly as to the form of design of the short circuiting rings. This company announce that they have also secured the agencies for the Independent Electric Company, Milwaukee, manufacturers of switch gear, and of the Premier Accumulator Company of Northampton, manufacturers of storage batteries.

New Dossert Rheostat Terminal

A new Dossert terminal connector which has been substituted for the old screw type terminals for making the connections from the dial to the grids of field rheostats in one of the largest power generating stations of the Metropolitan district is shown in the illustration. The shank of the connector is elongated so as to admit the cable in a direct line while the contact disc is slotted to fit over the grid and is offset slightly to the right or left respectively to facilitate the work of installation. The cable is held in the connector by the compression method characteristic of all types of Dossert connectors.

Handy rheostat terminal.

Colored Glass Lamp Hoods

The Reynolds Electric Flasher Manufacturing Company have recently placed upon the market a lamp hood or shade, which slips over an incandescent lamp bulb and is securely held in place by an ingenious fastening, and is both weather-proof and fool-proof. The hoods are made in all sizes to fit the 2½ watt, 5 watt, 10 watt, 20 watt, 25 watt and 40 watt mazda lamps, also the 10 watt and 50 watt carbon lamps or any bulbs styles S14 or S19. The hoods are made of natural colored blown glass in six colors. The hoods slip over the lamp bulb easily and may be removed just as easily in case of burnouts. These hoods are used extensively in spectacular electric signs and displays, for exit lights, elevator signals, canopy lamps and for decorative purposes of various description. Artificial coloring will fade, crack and wash off; also, either a natural or artificial colored lamp bulb has not the life of a clear lamp, engineering tests having proven that colored bulbs impair the life of the filament. Lamp hoods, on the other hand, permit the use of clear lamps and also provide for an air circulation around the bulb, so the life of the filament is not shortened. These lamp hoods appear to be a satisfactory and inexpensive substitute for lamp coloring.

Colored Lamp Hood.

P. & S. Lamp Receptacles

We illustrate herewith three Pass & Seymour lamp receptacles. Fig. 1 is a new porcelain cleat receptacle with shade holder groove to take standard porcelain socket shade holder. The same receptable is manufactured without the groove. Fig. 2 is a receptacle which may be used either on concealed work or on many of the Crouse Hinds condulets. Fig. 3 is what is known as an electrolier socket with flutolier

Fig. 1.

Fig. 2

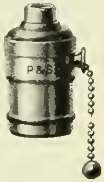


Fig. 3

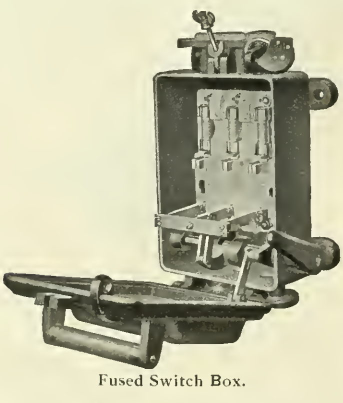
shell. This is a reduced size of the standard pull socket and is intended for use with fixtures only. They are considerably smaller than the standard socket thereby permitting a more artistic effect in high priced fixtures.

"D. & W." Fused Switch Boxes

To meet the demand for an improved, combined switch and fuse box, the D. & W. Fuse Company of Providence, R.I., have brought out a new line of fused switch boxes for 250 volt d.c. circuits. These boxes are particularly adapted for mill service since they may be permanently locked after the fuses are installed, thereby preventing any tampering with the connections or increasing the capacity of the fuses. At the same time, they can be used as a switch since the circuit can be opened or closed at will by simply moving the lever at the side of the box. By referring to the illustration you will note that when the cover is opened the circuit is likewise opened, which makes it impossible to re-fuse the circuit when the switch is closed.

In designing these boxes they have introduced no complicated mechanism, but have used a very simple but substantial construction which will give indefinite service, since the operation of the switch is not dependent on springs.

These boxes are provided with rubber gaskets which



Fused Switch Box.

render them positively waterproof provided that the terminal wires are taped in at the bushings or protected by outlet hoods when conduit connections are made. To facilitate installing these boxes removable porcelain bushings are used through which the cable terminals may be readily passed.

Trade Publications

Glassware—The Pittsburgh Lamp, Brass & Glass Company have just issued two handsome catalogues called Delica White Lighting Glassware and Cased Green Shades for Gas and Electric Lighting. These catalogues are well illustrated showing this glassware in their proper colors.

Pneumatic Tools—Bulletin 128 on Miscellaneous Equipment for Pneumatic Drills; No. 123 on Pneumatic Motors and Pneumatic Geared Hoists, and No. 133, Cylinder Air Hoists and Jacks; published by the Chicago Pneumatic Tool Company.

Peebles Dynamos and Motors—Pamphlets No. 16B and 21B, issued by Roper, Clarke & Company, Canadian agents, describing, respectively, Peebles alternating current motors of the polyphase induction type and Peebles continuous current dynamos and motors.

Rectifiers—Bulletin 100, by the Wagner Electric Manufacturing Company, St. Louis, descriptive of alternating current rectifiers, for use in charging batteries up to capacities of 15 amperes, 10 volts, and 7½ amperes, 12 volts. The principle of this rectifier is also described in the bulletin.

O-B Products.—The Ohio Brass Company have issued bulletins descriptive of their type J. all-wire rail bonds and of their fire hose-bridge and trolley pick-up. To these bulletins are attached postal cards by the use of which enquiries may be made with a minimum of trouble to anyone interested.

Rolled Steel Wheels—The Standard Steel Works Company, Philadelphia, has issued a new catalog on Rolled Steel Wheels. An interesting feature is the application of a number to each wheel, which number covers all standard dimensions except the bore. The process of manufacture is fully described with many detail illustrations. The standard sized axles for steam and electric service are also shown.

Watt-Meter Boxes—The Appleton Electric Company, Chicago, Illinois, has issued a complete booklet listing and describing their complete line of watt-meter boxes from 1 to 30, 31 to 60 and 65 to 100 amperes. Watt-meter boxes are approved by the National Board of Fire-Underwriters, and are approved and used by the city of Chicago in all apartment, store and office buildings.

Rolled Steel Wheels—Catalogue No. 12 issued by the Standard Steel Works Company, Philadelphia, descriptive of their solid forged and rolled steel wheels. "Standard" wheels are made from acid open hearth steel which is of uniform composition and with a given carbon content has a higher tensile strength and elastic limit both in tension and compression than basic steel, and is therefore superior for use in wheels which carry heavy loads and are subjected to much wear. The illustrations indicate the variety of equipment under which these wheels have been successfully used.

Theater Dimmers—In a new 24-page bulletin The Cutler-Hammer Mfg. Co. describe the latest type of Simplicity theater dimmer for two-wire and three-wire circuits. These dimmers are made especially for use with tungsten lamps and where an extremely fine regulation of the lamp brilliancy is desired. There are twice as many steps on the new plates as on the dimmer for carbon filament lamps. The diameter of the plates has also been increased two inches and two complete resistance windings can be carried on each side of the plate. These plates, however, can be carried on the same frame as the smaller ones. The bulletin contains very complete description and has many illustrations. Means of banking and control are discussed and dimensions given. The new Medinah Temple and Auditorium of Chicago and a number of eastern theaters have already been equipped with the dimmers described in this bulletin. Bulletin 8515 describing Spot Light dimmers is also being distributed.

Current News and Notes

Ashcroft, B.C.

The Atlas Power Company, Limited, has been incorporated with head office, Ashcroft.

Amherst, N.S.

The electric light station at Amherst, N.S., is reported to have been totally destroyed by a recent fire.

Battleford, Sask.

During the reorganization of the local power plant, energy will be purchased from North Battleford at the rate of 9c per kw. hour. Machinery for the Battleford power station has not yet been purchased.

Bowmanville, Ont.

The R. G. Sturgeon & Company are in the market for an equipment capable of lighting about fifteen 25 watt tungstens at a pressure of about 40 volts.

Brandon, Man.

The city council has voted to place the city of Brandon under the jurisdicton of the Public Utilities Commission of the province. This means that all public utilities within the municipality of Brandon whether municipally or privately owned come under the jurisdiction of this commissioner. These utilities include the street railway, the waterworks and sewers, the electric light company and the gas company.

Brantford, Ont.

The street car employees have received an increase of wages, the maximum being now placed at 20c instead of 17c per hour.

Carlyle, Sask.

The John Galt Engineering Company have submitted a report on the cost of a municipal light and power generating and distribution system. The report suggests an installation of a 35 kw. a.c. generator. The scheme also allows for the installation of fourteen streets lights. The cost of the system is placed at $12,400 and it is estimated that on a 15c rate the revenue should be $3,300 annually. An alternative proposition has been submitted by the R. A. Lister Company, whose price is approximately $7,000.

Chase, B.C.

The Adams River Lumber Company are installing an additional 60 kw., 1,000 volt generator to be belted to the line shaft in their saw mill for auxiliary use when on double shift. The generator is being manufactured by the United Electric Improvement Company of Philadelphia.

Edmonton, Alta.

Grading work has commenced on street railway extensions.

The city of Edmonton at the present time are spending between $200,000 and $300,000 in ornamental street lighting, the type of lamp used being the C. G. E. inverted arc.

The city of Edmonton have recently placed an order for a 100 kw. steam driven exciter set with Mr. F. S. B. Heward, Montreal agent for Jas. Howden & Company, Glasgow. The engine is to be of standard two-crank compound high-speed type operating at 500 r.p.m. under steam at 140 lbs. The dynamo will be supplied by the Electric Construction Company and will be a shunt wound continuous current multipolar type. Other Canadian installations made by this company recently, include two engines for the Canada Iron Corporation at Midland, one for the Robt. Simpson Company, Toronto, one for the Montreal General Hospital, and one for Nanaimo, B.C.

Fredericton, N.B.

The annual report of the New Brunswick Telephone Company shows that the total number of instruments installed is 12,915 being an addition of 1,624 for the year 1912. During the same time 114 miles of rural circuits have been constructed. It has been decided to establish an exchange at Gagetown to accommodate thirty-five telephones. The net revenue for the year was $88,681.

Galt, Ont.

The Galt water system is now being operated electrically. The electrical equipment consists of a 250 kv.a., 2200 volt, 25 cycles, 750 r.p.m. motor supplied by the Swedish General Electric Company.

Goderich, Ont.

The Ontario railway board are holding a preliminary investigation into the financial condition of the Ontario and West Shore railway. This is the line that was intended to be operated electrically between Goderich and Kincardine. It is said that certain moneys guaranteed by the municipalities, or by the farmers more directly interested, cannot be accounted for.

Hamilton, Ont.

In connection with a recent report that the Dominion Power & Transmission Company would commence the construction of a suburban electric road between Hamilton and Galt in the near future, we learn that, though preliminary surveys have been made and that the line will undoubtedly be built in the near future, it is not probable that work will be commenced this year.

The City of Hamilton are considering the proposition of installing the largest electrical sign on record, advertising the City of Hamilton by the words "Hamilton Cheap Power." The actual dimensions are not yet decided upon but by using the 300 ft. elevation of the mountain together with a reasonable elevation of the sign it is expected to have the advertising feature visible for many miles.

Hull, Que.

The Hull Electric Company gave considerable encouragement to the young ladies who collected for the hospitals in Hull on Tag Day, May 17th. Besides giving a cheque for $20 to the Hull hospital the company entertained the workers at luncheon in the waiting room on Main street.

Kamloops, B.C.

A by-law was carried on June 3rd, to expend $260,000 on the erection of a hydro-electric power plant on the Barriere River, some 40 miles north of the city.

A by-law authorizing the expenditure of $120,000 to extend the electric lighting system carried on June 3rd.

The Marcus Electrical Company, Limited, has been incorporated with head office at Kamloops, B.C.

Melita, Man.

By a vote of 123 to 1, the ratepayers of Melita on May 17th, granted a franchise to Mr. R. E. Denny for the supply of light and power in the town. Mr. Denny promised in case the franchise were granted, that he would make a reasonable test for gas in the district, and in the case of it being discovered in merchantable quantities an electric light and

power plant will be installed. The by-law also grants Mr. Denny the right to install a waterworks system and a street railway system, a term of years being allowed in each case.

Medicin Hat, Alta.

The provincial government will erect a three-storey telephone exchange building with provision for 10,000 subscribers The installation will be the automatic system.

Minnett, Ont.

Mr. Arthur Minett, proprietor of the Cleveland House, is installing a gasoline electric plant. The equipment is being supplied by the R. A. Lister Company.

Morrisburg, Ont.

A by-law will be submitted in the village of Morrisburg granting a right-of-way along certain streets in the municipality for the operation of a railway by the Ottawa and St. Lawrence Electric Railway Company.

Montreal, Que.

In connection with the widening of the aqueduct, Montreal, and the generation of ten thousand horse power, four thousand of which will be utilised for lighting the city, eight tenders have been received. The lowest is by the Cook Construction Company, Limited, of Sudbury, Ont., the price being $2,322,562. This includes the construction of two boulevards, on which it is proposed to run lines of tramcars. The whole scheme has been attacked on the ground that the city is able to secure electrical power from companies cheaper than it can be generated under the aqueduct scheme, and that the latter is not a commercial proposition. In addition to the higher cost of power, which is put at $36.55 per horse power per annum for lighting, there will be heavy charges for distribution. The city officials reply that they have taken expert advice from Canadian and U. S. engineers, and that the cost to the city, having regard to the saving of coal and other charges, will be $12.62 per horse power.

The Montreal Council have given the Montreal Tramways Company permission, until further notice, to haul freight.

The Cedars Rapids Manufacturing and Power Company have been given leave to appeal direct to the Judicial Committee of the Privy Council from a decision by Mr. Justice Davidson in connection with the expropriation of certain islands belonging to the De Beaujeau estate situated near Cedars Rapids. The company offered $4,700 for the islands, and this was confirmed on arbitration, but Mr. Justice Davidson ordered the payment of $142,000 for one of the islands, the expropriated rights on another, and another was left over for a further award. The judge held that the proprietors should be paid not only for the value of the land but also for the hydraulic rights and possibilities. The company object to the manner in which the values were arrived at.

An action by Mr. D. Robertson, purchasing agent of the Montreal Tramways Company, to prevent the carrying out of a contract between the Canadian Autobus Company, Limited, and the City of Montreal has been dismissed. An appeal, however, is to be made against the judgment of Mr. Justice Demers in the Supreme Court. The action was to stop the running of autobuses.

The Montreal Light, Heat and Power Company have reduced the price of lighting from 7c per kilowatt hour nett to 6.40c nett. This is the sixth consecutive annual reduction. The company state that the new rate applies only to aerial and overhead service. Underground service, such as is now being planned by the city under taking to place all wires in conduits and charge the various companies rental for the same, will prove more expensive, and the present rates will have to be adjusted somewhat in the districts where the conduits are laid.

J. Stone & Company, Limited, an English firm, have written to the Maisonneuve, P.Q., Council, stating that they propose to construct a large electrical engineering factory in the precincts of the city, and asking what concessions the Council will give them. The secretary-treasurer was directed to ascertain full particulars regarding the proposed building and the number of workers to be employed.

Five Canadian representatives were present at the Annual Meeting of the Association of Railway Telegraph Superintendents at St. Louis, Mo., which was the largest attended gathering in the history of the Association. The Canadian representatives were Mr. W. J. Camp, assistant manager of the C. P. R. Telegraph Department, Montreal; Mr. Richardson, superintendent of the B. C. division of the C. P. R. Telegraph Department; Messrs. W. Ashald and T Rogers, of the Grand Trunk Telegraph Department; and Mr. A. D. Smith, of the Northern Electric & Manufacturing Company. Mr. Richardson and Mr. Camp took part in the discussion. The next meeting will be held at New Orleans in May, 1914.

Newmarket, Ont.

By a small majority, a by-law authorizing the franchise contract between the town of Newmarket and the Toronto and York Radial Railway Company was defeated. As a result of their conviction that it would be very unwise, under the circumstances, to install Hydro-electric power, the council later resigned in a body.

Orillia, Ont.

Mr. W. K. Greenwood, city electrician, has submitted a report on the lighting of the main street. The report provides for the use of five-light ornamental standards on both sides of the street. Separate estimates have been made of the cost of overhead and underground service wires.

Ottawa, Ont.

The supplementary estimates contain an item of $75,000 for the rewiring of the Parliament Buildings. Much of the wiring of these buildings has not been in conduit and as a result the fire hazards are unnecessarily heavy.

Owen Sound, Ont.

The revised report of the Hydro-electric Power Commission of Ontario with regard to the cost of power in Owen Sound shows that, including distribution, the cost to the consumer would be approximately $40. This is against the present calculated cost of $50 per h.p. year with steam equipment. If it is the wish of the council the Hydro-electric Commission is ready to proceed with the development of Eugenia Falls.

Pelee Island, Ont.

A telephone system is contemplated. A committee has been appointed to look into the matter.

Port Coquitlam, B.C.

A syndicate of local business men are considering the establishment of a private telephone system to serve the residents of the town, as a result of dissatisfaction with the present service. It has been suggested that the automatic system will be installed.

Prince Albert, Sask.

Plans and specifications are being prepared for a new modern steam generating station, prime movers to be condensing steam turbines connected to a.c. alternators 2,000 kw. capacity each, boilers to be water tube 5,000 h.p. capacity equipped with mechanical stokers, fed by up-to-date coal

handling machinery. Electrical superintendent, Mr. R. Wright.

Pelham Centre, Ont.

A committee has been appointed to canvass the surrounding sections with a view to determining the amount of light and power load that could be obtained if the Hydro line were run to this point.

Regina, Sask.

A by-law was submitted on June 12th, authorizing the operation on Sundays of the Regina municipal railway system.

Russel, Man.

A by-law was passed recently to expend $18,000 on an electric lighting plant.

Sherbrooke, Que.

The Sherbrooke Railway & Power Company have requested the city to revise the contract made three years ago in regard to the route of the car lines. Owing to the growth of the city the company state that to meet the requirements of the contract certain changes not previously contemplated will have to be made.

St. Thomas, Ont.

The St. Thomas Biscuit Company will install 150 h.p. in motor capacity and will require all auxiliary equipment.

The Western Ontario Electric Company has been incorporated with head office, St. Thomas.

St. John, N.B.

A contract has been awarded to the W. O'Leary Company, Montreal, for the installation of an electric lighting system in the Cathedral of the Immaculate Conception.

Sorel, P.Q.

The council has under consideration the installation of an electric fire alarm system.

Saskatoon, Sask.

Fifteen by-laws were recently voted on by the ratepayers of Saskatoon, and not only did every by-law carry by a large majority, but there was not a single ward in which an adverse vote was accorded on any one of the by-laws. Street car and electric light extensions were among the most favorably received.

On a recommendation of Superintendent Edward Hanson, the council has awarded the contract for the supply of steel for street railway extensions to the Canadian Steel Foundries, Limited.

Sunderland, Ont.

A by-law was carried on May 22nd, to authorize the expenditure of $5,800 on a hydro-electric distribution plant.

Tweed, Ont.

A by-law will be submitted to the electors on June 16, authorizing an agreement between the village of Tweed and Tweed Electric Light & Power Company, Limited. The company agree to erect a plant and supply energy for light and power in the village. The household lighting rate is to be 9c per kw. hour. The street lighting will include fifty 40 watt tungsten lamps and forty 60 watt tungsten lamps, for which a yearly rate of $970 shall be paid.

Toronto, Ont.

H. M. Queen Mary, on June 3rd, opened the Sanitorium for Consumptives at Weston, Ont. Her majesty closed an electric circuit at Buckingham Palace, London, which was directly connected, by means of the Commercial Cable and C. P. R. telegraph systems, to electrical equipment in the hospital. The connections between the land line of the cable system were by means of the invention of Mr. Gott, recently described in the Electrical News. An acknowledgement of the signal was telegraphed directly to Buckingham Palace.

A report will be made to council by Messrs. R. A. Ross, consulting engineer, Montreal, Bion J. Arnold, New York, and J. W. Moyes, Toronto, on the value of the property of the Toronto Electric Light Company and the Toronto Railway Company.

The Hydro-electric Power Commission of Ontario will prepare estimates on the cost of an electric railway line connecting the city of Toronto with the towns lying north-easterly, including Markham, Stouffville, Port Perry, Uxbridge, etc.

The city has commenced work on the road-bed for the Terauley street railway line, which will connect up with the Anderson and St. Patrick line. This is part of the Toronto Railway Company's system.

Vernon, B.C.

The corporation of the city of Vernon, B.C., are spending, during the present year, some $85,000 on their generation, distribution and lighting system. $50,000 of this is for an additional oil engine and generator, and $8,000 for ornamental street lighting. The municipality, with a view to popularising the use of electric ranges, are supplying these to their customers on a monthly instalment basis.

Vancouver, B.C.

The North Coast Electric Company, Limited, has been incorporated with head office Vancouver.

Welland, Ont.

Mr. C. J. Laughlin, vice-president of the Nigara, Welland and Lake Erie Electric Railway Company has stated that the extension of the street railway system to Dain would be undertaken within a very short time and completed by September 1st.

The Electric Steel and Metals Company, Limited, has been incorporated to carry on business as an engineering supplies and construction company, railway, civil, mining and electrical engineers, etc., with head office at Welland.

Estimates have been prepared on the cost of placing the wires underground. The cost of 6,000 ft. of four duct construction was placed by the engineer at $16,500.

Winnipeg, Man.

Commissioner Robson has handed down a judgment in the matter of overhead electric distribution in the municipality of Kildonan. The commissioner advocates the joint use of electric poles. This matter affects principally the Winnipeg municipal system and the Winnipeg Electric Railway Company.

Tenders are called till June 30th, for 240 ornamental street lighting standards.

Yorkton, Sask.

A by-law will be submitted to the electors on June 20th, authorizing the expenditure of $140,000 for extending the present plant of the town and for distribution for light, heat and power purposes.

Personal

Mr. Frank E. Filer has been appointed manager of the Winnipeg office of the Packard Electric Company.

Mr. Herbert C. Barber has joined the sales staff of the Packard Electric Company, with headquarters at Toronto.

Amongst the recent orders secured by the Packard Electric Company are the following: City of Edmonton, four 1000 kv.a., 60 cycle, oil-insulated, self-cooled, 3-phase, 13000 volt transformers; City of Calgary, three 150 kv.a., 60 cycle, oil-insulated, self-cooled transformers; City of Winnipeg, six 100 kv.a., 60 cycle, oil-insulated, self-cooled, 12000 volt transformers.

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The Convention

Canadian electrical men have reason to be proud of their 23rd Annual Convention not only in point of attendance, but in that the program, both from an intellectual and entertainment point of view, was one of the best that has ever been prepared for such an occasion. The papers were uniformly excellent and in nearly every case brought out a quantity of spirited and very helpful discussions. It is a fact, however, that the time at the disposal of the delegates does not allow them to discuss the various problems as thoroughly as they could wish. It would appear either that the number of papers should be reduced or, that the duration of the convention should be lengthened, for there can be no question but that the most valuable part of any paper is the discussion which follows it. It is open to question if the object of the convention might not be made rather the discussion of papers than the mere reading of them. It does seem a mistake to bring delegates from Winnipeg or Vancouver or Halifax to hear an author read a paper to them when in the same length of time they could read it themselves, before they started, if it were in their hands. What appears to the writer as the legitimate object of such an association is the exchange of the points of view of the different operating men, the paper being taken as the basis on which to build up an amount of useful practical information.

The suggestion is thrown out that if these papers were prepared a little in advance of the convention so that they may be in the hands of electrical men all over Canada, say two weeks before the convention date, the result of such a course should be two-fold, first, that a delegate would read the particular papers, carefully, in which he is most interested, and would prepare himself between that date and the convention to take part in the discussion, ask questions and express his own point of view or the results of his own experience. The other advantage would be that many men who may not have an early intention of attending the convention might become interested in the subjects brought forward by these papers to such an extent that they would feel called upon to attend the convention, hear the point of view of many other men operating under conditions similar to their own and probably take a hand in the discussion themselves. Such a course also would make it possible for a number of delegates, who may not have sufficient confidence in their own oratorical powers to get on their feet and make an impromptu speech, to prepare their statements in written form. This would have the further added advantage that copies of these questions or points of view might be handed in to the author of the paper, who would thus be prepared beforehand to deal with these questions in a much more comprehensive way than he is often able to do on the spur of the moment.

There was undoubtedly a considerable amount of disappointment on the part of municipal ownership men that the question of enlarging the scope of the association did not receive more favorable consideration. The information gathered by the executive and embodied in a report showed a strong feeling in favor of such a change and the talk around the lobbies was in much the same vein. The advocates of reorganization were, however, apparently unprepared to take a decided stand in the matter, being unwilling to commit themselves to any change for which the time might not be ripe. All were agreed that the present arrangements were better not disturbed unless there were a reasonable and almost absolute guarantee of the success of a new association. As a result the question is ostensibly shelved for another year. The feeling of the private companies is decidedly and, naturally, strongly in favor of continuing their close relation with the N.E.L.A. This is not at all to be wondered at in view of the very valuable work this association has done and the immense amount of information it has collected and placed at the disposal of its members. On the other hand, municipal men have no similar source of information and feel the need of an electrical organization which may well be formulated with an object in many ways similar to the N. E. L. A., excepting, of course, that its membership would be entirely general. The suggestion of Mr. Dion that the possible solution of the difficulty lay by way of the private companies relinquishing the name, The Canadian Electrical Association, and still retaining their connection with the N. E. L. A., appears to be the best in sight. This would open the way for the organization of a Canadian electrical association to include all electrical men, but would not deprive the private companies of the advantage at present received from the affiliation. That something will be done along this line within the next few months appears probable at the present moment.

Auxiliary Plants

The inevitable has happened—the transmission line of the Hydro-electric Power Commission of Ontario with its manifold factors of safety has in its turn been put out of commission by adverse atmospheric conditions, unfortunately for two periods of several hours duration each. We do not believe this has been a matter to cause any satisfaction to even the worst enemies of municipal ownership, but it is rather an experience from which all should profit. It seems an unanswerable argument in favor of auxiliary equipment for every generating plant serving a manufacturing district. The financial loss to a manufacturer during a pro-

longed shut-down is very great, and when we try to calculate the total loss, direct and indirect, over the immense area served by the Ontario Commission, it is evident that the amount soon becomes comparable with the cost of installation of the necessary auxiliary plants. Such auxiliary plants are also very valuable in keeping down the peak load, which forms the basis on which payment for energy is generally made. Added to this, there is the certain feeling in the minds of customers of any system that has once failed, that the same thing will likely happen again, and this makes it more difficult to take on new customers or increase the load of the old ones. Undoubtedly the best advertisement a distributing system can have is an unbroken record for uninterrupted service.

The Ontario Commission's line has been so well constructed, it has scarcely been criticised. The simultaneous failure of two circuits so splendidly designed as these were, and at the same time so thoroughly isolated from one another only means that no single source of power can give the guarantee demanded by modern commercial life. This mishap also indicates the direction in which the greatest need lies for engineering, ingenuity and improvements—the perfection of apparatus to prevent disturbances on transmission lines. The various so-called lightning protection devices in such cases simply do not protect. Whether electrical engineering knowledge will ever, in the distant future, reach that point of perfection where all the vagaries of the lightning flash can be foreseen and guarded against, only the future can say, but in the meantime it is evident that continuous service can be had only at the price of a duplicating plant of one kind or another.

Electric Vehicle Association

The Publicity Committee of the Electric Vehicle Association of America through its chairman, Mr. Frank W. Smith, reports splendid progress in the work of the committee soliciting funds to carry forward for another and second year the National Co-Operative Publicity Campaign to promote the use and adoption of the electric pleasure and commercial vehicle. As already reported in these columns, this Association is doing splendid work for the electric vehicle industry. The membership of the association shows a very healthy growth.

The fifth annual convention of the association will be held during October 27-28. The Publicity Committee announces a total amount so far pledged as approximating $35,000, and is making a final plea so as to bring the amount to at least the sum expended for the first year. A special appeal has been made to the central station interests, a final plea being in the form of a very attractive circular and return stamped post card to those central stations which have not already subscribed asking that every company contribute a "booster" or "good will" contribution of at least something. The return post card is arranged so that the amount of subscription may be indicated by a check opposite the printed figures, this being the only action necessary on the part of the contributor as the return post cards are serially numbered, which number identifies the subscriber. It is only necessary to indicate by check opposite the amount to be subscribed and drop the card in a box, the association will do the rest.

A Correction

In an article appearing in our June 15th issue on "The Growing use of Electricity on Farms," the first paragraph under the sub-head "Actual Installations" line 13, is made to say "a load of 2 h.p. to the mile", this is a typographical error and should read "a load of 8 h.p. to the mile," to correspond with the statement made in the last line of the article.

Storage Batteries for Small Towns

The corporation of Yellowgrass, Sask., have recently added to their generating equipment a storage battery of 60 cells with a capacity of 1200 amp. hours. This is in connection with a 17 kw. generator driven by a 25 h.p. gasoline engine which the town installed some 2 years ago in connection with their water system. The storage battery has been in operation about two months, and in that time it has been demonstrated that the engine is only required to operate about three hours a day to charge the battery and a little longer on Saturdays to provide for the Sunday load. The cost of the whole plant including three miles of pole line, street lamps and the necessary house meters, was $10,300. The battery was installed by the Accumulator Lighting Company of Winnipeg.

Mayor Allen of Yellowgrass has stated that the storage battery lighting plant is giving perfect satisfaction and that he recommends a similar installation to any town requiring a lighting plant. One of the outstanding advantages of such a system is the availability of a twenty-four hour service, the lack of which causes great inconvenience in towns where only a limited hour service is supplied.

Campbell River Power Company

The importance of Vancouver Island as a field for the development of electrical energy on a large scale has long been recognized, and the confirmation of a report to the effect that the Campbell River Power Company of Victoria has plans under way for the establishment of a gigantic hydro-electric project on Campbell River, at the northeastern portion of the Island, will no doubt arouse a great deal of interest in electrical circles throughout the Dominion. According to the limited information at present available, the plans of the company involve an ultimate expenditure of approximately $12,000,000 on the development of 300,000 horse power from the waters of the three falls of the Campbell River at a higher voltage than any existing power plant in British Columbia.

A corps of engineers is now engaged in detail surveys and estimates, and as water rights and incorporation have already been secured, a start on the plant is anticipated as soon as the estimates are in hand—probably some time during the coming summer.

It is the intention of the company to sell electrical energy all through Vancouver Island. Mr. George C. Hinton, of the Hinton Electrical Company, Vancouver and Victoria, is one of the promoters of the new company. It is understood that arrangements have been made to secure ample capital for the enterprise from English sources.

Street Lighting in South Vancouver

The question of an ample, efficient and economical system of electric lighting and power for South Vancouver was introduced at a recent meeting of the council, when Mr. L. F. Rawden, municipal electrician, made a report as to the cost of such in the municipality compared with several cities in the Dominion. As the cost of street lighting alone is not so efficient or so economical as it might be in South Vancouver, the comparative figures given were of sufficient interest to merit serious consideration. The matter of an adequate street lighting and power system is not only of particular interest to residents, but also to manufacturers to whom cheap power is essential to successful production. This latter desideratum is of special importance to municipalities desiring to induce industries to locate in their district.

In the course of Mr. Rawden's report it is stated that last year the municipality paid $13,400 for street lighting alone for half-night service of about 300 lamps, and this

year over 600 lamps are burning at an estimated cost of $25,000. In the event of the council insisting on an all-night service this winter as was the case last year, the electrician pointed out that this lighting estimate would be exceeded. The present municipal contract has seven years to run. On investigating other municipal lighting systems and from his own personal experience, Mr. Rawden claimed that the municipality could operate a street lighting plant and give a much lower rate provided the council would install a plant to supply incandescent lighting for householders and power for manufacturers. The latter would encourage the establishment of industries in the district and would offset the cost of street lighting. The members of the council were favorably impressed with the idea, and instructed the electrician to prepare a report on the cost of providing an electric plant for supplying incandescent lighting in the municipality.

Vancouver's Electric Truck Garage

The British Columbia Electric Railway Company, Limited, has recently advanced the prospects of the electric vehicle business in Vancouver by opening a fully equipped garage for this type of equipment, view of the interior of which is shown on this page.

The chief object of the company in arranging for this garage is to accommodate the demands of owners of commercial trucks, the sale of which the company is now pressing vigorously. It is the intention to leave the business of caring for electric pleasure cars to the owners of private garages, a number of these establishments in Vancouver being equipped for this purpose.

The B. C. Electric garage is located in the heart of the business district, thus being convenient for the firms operating electric trucks. The floor space for the vehicles is 90 x 170 feet, which will permit of the accommodation of from 50 to 60 cars, according to size. Located to advantage on the ground floor are the offices of the superintendent of the station and another compartment for battery room and workshop. On the upper floor is a large room for storage, where spare parts, etc., are kept.

The electrical equipment consists of a d.c. motor generator set of 75 k.w. capacity, with an emergency set consisting of a 50 h.p. motor belted to a 45 k.w. generator. A complete switchboard apparatus and necessary equipment for charging is also provided. All the charging lines are laid in conduit under the cement floors.

At the present time about 15 cars are taken care of at the garage. The service given consists of the storage of the car, daily washing and oiling, charging of batteries as needed (this work being done, as usual, at night although the firms are urged to have their men look after their cars and have the batteries "boosted" at noon if there is need) and the making of minor adjustments and repairs. The force now employed at the garage consists of a superintendent, three operators and a washer. The rates charged for the services noted above are as follows:—

Cars 750 and 1000 lbs	$45 per month
1 tone trucks	55 per month
2 ton trucks	60 per month
3½ ton trucks	65 per month
5 ton trucks	70 per month

The usual charge for the keep of electrical pleasure cars at Vancouver garages is from $30 to $35 per month, the garages sometimes offering in connection with the services the calling for and delivery of the cars.

The B. C. Electric has done good missionary work this year in the introduction of electric commercial trucks in Vancouver. As soon as it was decided to take up an agency an experienced man was engaged who was acquainted with both the selling and garage ends of the business. An advertising campaign was conducted through the daily press, circular letters, pages in auto magazines, etc., which aroused keen interest in the business. As the firm operates a number of electric trucks in its own business, the "prospect" was usually given the opportunity of testing out a car in a day's work at his particular form of business, this form of canvassing being very telling in results. Since spring, two hotel busses have been sold, each of 1 ton, a 2-ton truck to a wholesale fruit firm, a 2-ton truck to a wholesale hardware firm, a 1-ton truck to another hardware firm, and three trucks, ranging from 750 lbs. to 3½ tons have been taken by the company for its own business. Through other dealers another 2-ton truck has been secured by a wholesale milling firm which made the purchase after a year's trial of an electrical truck at another point on the coast. The company's representative reports that keen interest is being taken in the operation of electric trucks and that his "prospects" are numerous, the indication being that a good business will be done in the near future.

Montreal Electrical Association

Mr. P. T. Davies presided at the annual meeting of the Montreal Electrical Society held on June 6th at the Edin-

B. C. E. R. Garage for electric vehicles, Vancouver.

burgh Cafe. The reports submitted and the speeches made show that the society has more than fulfilled the expectations of the founders, the membership now numbering 375. In his opening address Mr. Davies spoke of the harmonious working of the executive committee, and the aid received from the various sections of the society. He suggested that the membership was now sufficiently large to warrant the renting of permanent quarters while it was also possible that in the near future educational classes, as distinct from the ordinary meetings, would be held. Mr. J. C. Bray, secretary, and Mr. W. H. Tees, treasurer, submitted their reports, which were adopted, and votes of thanks were passed to the officers. It was stated that the treasurer had a balance in hand of about $100.

The following officers were elected: president, T. H. Nicholson; vice-president, T. N. White; secretary, J. C. Bray; treasurer, W. H. Tees. The executive board is composed as follows: Traction, J. M. Mochon; telephone and telegraph, W. H. Winter; power, W. J. B. Drew; construction, T. E. Salter; manufacturing, L. E. Hamilton; contracting, U. A. Luduc; commercial, H. L. Etienne.

New Barracks Tenders Called

Tenders have been received in connection with the erection of the new barracks at Long Branch, 10 miles west of Toronto. The specifications indicate in detail the electrical requirements which are chiefly for lighting and motor purposes. The extent of the lighting requirements may be judged from the following list:—

671 single light fixtures, with 60 watt lamps.
16 single light fixtures, with 100 watt lamps.
8 single light fixtures, with 150 watt lamps.
23 three-light chandeliers, with 60 watt lamps.
23 five-light chandeliers, with 60 watt lamps.
37 ceiling balls, each with one 60 watt lamp.
6 brackets with single lamp, 60 watts.
38 brackets with single lamp, 25 watts.
13 plug receptacles.
3 floor outlet boxes.
4 single light fixtures, with 60 watt lamps to be used at boilers.
592 push button switches.
2 three-way switches.
22 panels for lighting.
4 panels for power.

The motors are principally for ventilation purposes, which will require fourteen on the 3rd floor, each from 2 to 2½ h.p. capacity. There will also be two 3 h.p. motors for ventilating fans on the basement floor, two 5 h.p. motors for sump pumps and two electric air line pumps requiring a 1 h.p. motor each.

All wires will be distributed in conduit, the lighting distribution being 3-phase, 110 volts with single phase, 110 volt branches.

The committee of the International Engineering Congress have effected a permanent organization with Prof. Wm. F. Durand, as chairman, and W. A. Cattell as secretary-treasurer, and have established executive offices in the Foxcroft Building, 68 Post Street, San Francisco.

Pacific Coast Convention A. I. E. E.

In connection with the Pacific Coast convention of the American Institute of Electrical Engineers to be held in Vancouver, B.C., September 9, 10, 11, the following committees have been appointed:—

General Committee: R. F. Hayward, chairman; E. M. Breed, secretary; F. D. Nims; D. P. Roberts; J. R. Read.

Papers Committee: Messrs. F. D. Nims, chairman; D. P. Roberts; W. W. Fraser.

Transportation Committee: Messrs. E. M. Breed, chairman; J. R. Read; J. Montgomery; E. R. Pease; H. N. Keifer.

Entertainment and Reception: Messrs. L. G. Robinson, chairman; R. H. Sperling, J. Shand, W. V. Hunt, G. R. Wright, W. J. Lister, C. M. Beebe.

Finance Committee: Mr. E. McNeil.

The Papers Committee have tentatively arranged a program of seven papers, including one paper to be presented in the evening as an illustrated lecture. It is proposed to present only one paper each session so as to give more ample opportunity for comprehensive discussion.

Following the regular business of the convention, two trips are being arranged, one to the plant of the Western Canada Power Company, Stave Falls, and the other to the plant of the Vancouver Power Company, at Lake Buntzen.

Telephone Institute Formed at the Coast

Organization was recently completed of the Telephone Institute of British Columbia, formed in connection with the B. C. Telephone Company, Vancouver. The object of the Institute is to enable the heads and principals of departments to get together for the discussion of matters in which the different departments act in conjunction, so that full knowledge of important subjects under consideration may be possessed by all. The membership was enrolled complete at thirty-seven.

Meetings will be held on the first Monday of each month. At the next meeting Mr. E. P. Labelle, plant engineer, will give a paper on the new cable which was laid last month.

Pringle vs. Canadian Moloney Company

Application for hearing has been made in the High Court of Justice, Ontario, between R. E. T. Pringle, plaintiff, and the Canadian Moloney Electric Company, Limited, defendant, in the matter of certain claims in connection with the winding up of a previous partnership. The plaintiff claims:

(1) That an account be taken of all orders obtained by the plaintiff from customers in Canada from the 1st July, 1911, to 31st December, 1912, and also of all orders obtained by the plaintiff for the defendant from the 1st of January, 1913, to 31st March, 1913, and accepted by the defendant and of the amount commission due to the plaintiff in respect thereof.

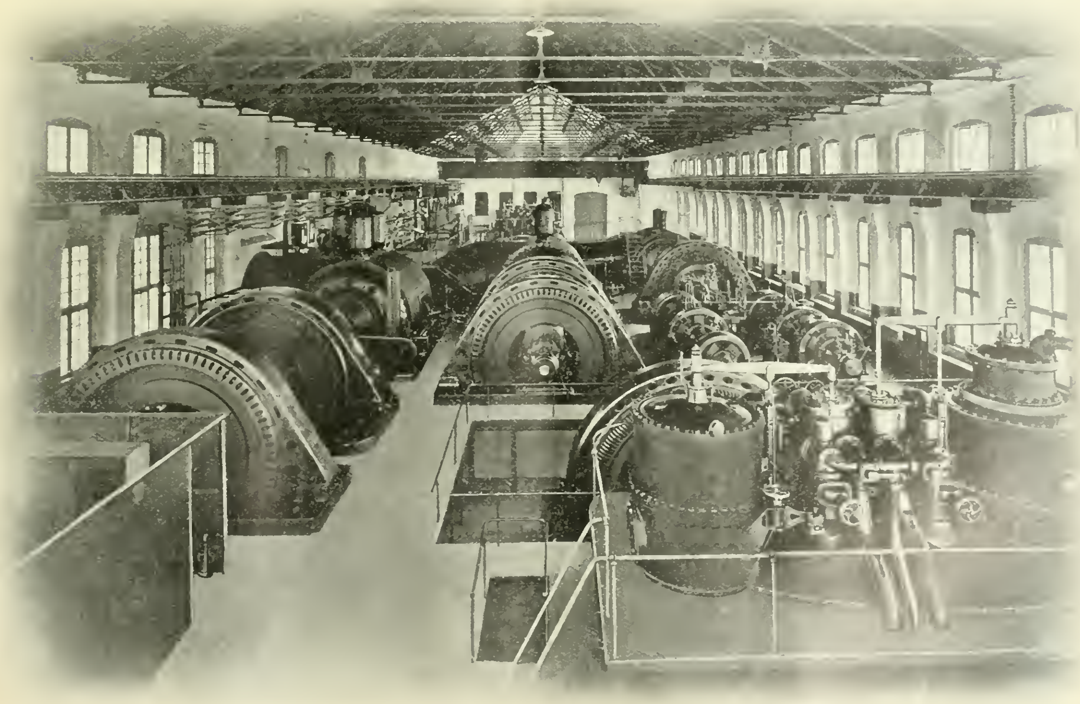
(2) That an account be taken of the amount due by the defendant to the plaintiff in respect of commission as general manager of the defendant company from the 1st of July, 1911, to 31st December, 1912.

(3) Payment by the defendant to the plaintiff of the amount found due to the plaintiff on the taking of such accounts.

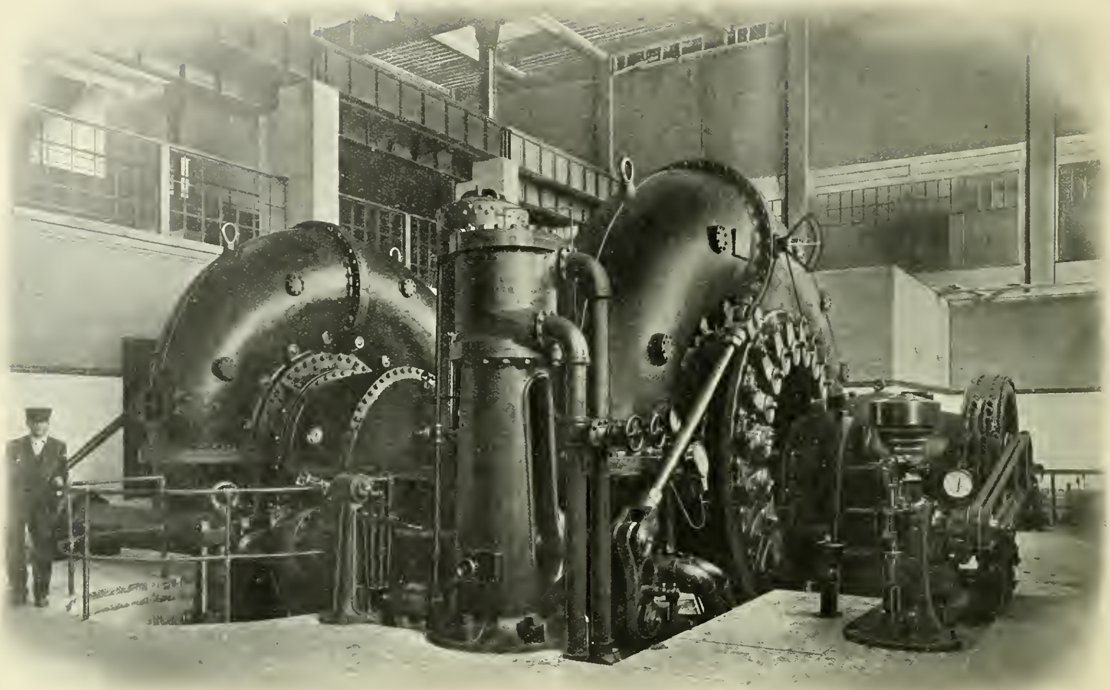
Shawinigan Water & Power Company

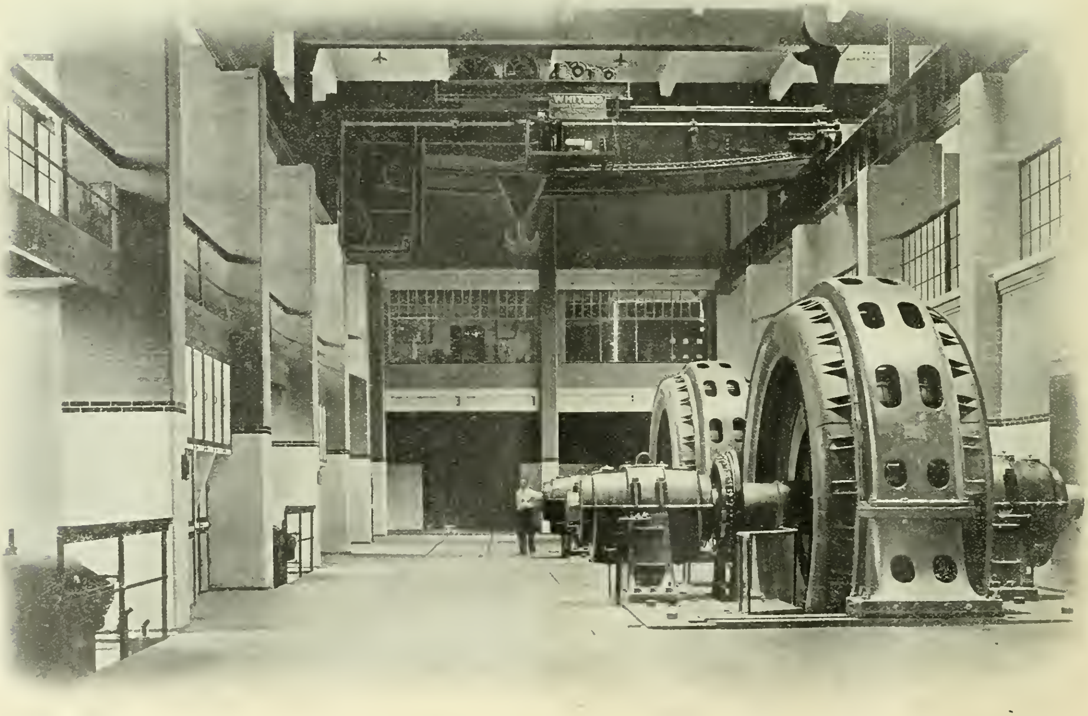
The illustrations on the two following pages show the magnificent developments at Shawinigan Falls of the Shawinigan Water & Power Company. It will be remembered that the capacity of power house No. 1 consists of six turbine units, three of 9,000 h.p. and three of 10,500 h.p. each, giving a total capacity of 58,500 h.p. The generators are 2-phase, 30 cycles, 2200 volts.

The layout of power house No. 2, when completed, will be such that there will be five units each with a normal rated electrical capacity of 16,000 h.p. or a total of 80,000 h.p. The general scheme of this layout is to divide the power station into two divisions, each consisting of two units with the third unit in the centre, which will be considered as a spare. Generation in power house No. 2 is 3-phase, 60 cycles, 6600 volts, which is raised to 100,000 volts for transmission.



Shawinigan Water and Power Company. Upper figure shows both power developments; lower figure shows interior of power house No. 1.





Shawinigan Water and Power Company, Power House No. 2: upper figure shows 18,000 h. p. double turbine; lower figure two 15,000 kw. generator

Canadian Electrical Association Convention

A Splendid Collection of Papers—Lively Discussions, Especially on Commercial Topics—An Enjoyable Entertainment Program.

The 23rd annual convention of the Canadian Electrical Association was held in Toronto at the Chemistry & Mining building of the University of Toronto on Wednesday, Thursday and Friday, June 25, 26 and 27. In point of good attendance and enthusiasm there has been no more satisfactory convention in the history of the Association. Mr. W. L. Bird, the superintendent of the Kaministiquia Power Company, Fort William, this year's president, made a very acceptable master of ceremonies, and by his timely remarks succeeded in keeping the discussions at a high state of enthusiasm during the entire period of the convention proceedings. Mr. Bird's opening address, though brief, was a careful review of the electrical situation at the present time, covering the developments of the past year and indicating the direction along which improvements may be expected in the near future.

Reorganization

At the end of the morning session of the second day of the convention the question of re-organization of the Canadian Electrical Association was introduced by the president, Mr. Bird, who called for a report on the returns from certain enquiries that had been sent out a few weeks before to ascertain the opinions of electrical men. The report explained that at the request of the executive committee of the association some 1,000 cards had been sent out requesting an opinion on the advisability of a re-organization of the present association on broader lines and so as to include also, among others, the men who are employed by municipal electric plants. The report explained that the answers had been somewhat fewer in number than could have been hoped, largely due, probably, to the fact that the queries sent out had, of necessity, been made more or less indefinite. The report showed, however, that, summing up the votes that had been returned, the majority was vastly in favor of re-organization, in the ratio of about 4 to 1.

Following the reading of the report a spirited discussion followed, in which Messrs. Lambe, Philip, Moore, Gould, Dion and others took part. Mr. Lambe favored the re-organization on such a basis as would include himself, for example, and numerous other men he knew of who were not eligible under his present constitution. Mr. Philip was in the position of a man who had formerly been associated with a private company, and as such had been in favor of including only private companies in this organization. Under his present circumstances, as superintendent of a municipal plant he felt that there was no real reason why he was not still eligible to the same Canadian Electrical Association, and he thought it was only reasonable to ask that the scope of the present organization should be enlarged so that men in the same position as himself might be included. He was confident that he spoke for a large number of the men situated similarly. Mr. Gould, while representing a private company and acknowledging the value of the National Electric Light Association with which he said he would not care, under any circumstances, to sever his connection, was also strongly of the opinion that an association broad enough to include all electrical men in Canada was much needed today. Mr. Moore spoke along the same lines.

Mr. Dion, as an advocate of retaining the present arrangement, replied to the above speakers. He recognized the point of view of every one of them, and in doing so, stated that under similar circumstances he had little doubt that his views would coincide with theirs. He was in the position, however, of being associated with a private company. If the Canadian Electrical Association was to be carried on as a business organization where the heads of departments could meet and discuss methods of management, etc., he was strongly against any change in the present order of things. Mr. Dion counselled caution and delay lest a new association might be formed under circumstances that would not give sufficient guarantee of its success. He also drew attention to the great value of the connection with the National Electric Light Association and stated that under any circumstances his company could not afford to relinquish that connection. He threw out one suggestion—the possibility that perhaps the private companies which at present constitute the Canadian Electric Association might think well of relinquishing that name and still retain their connection with the N.E.L.A. under, possibly, a new name. This would then leave the field open for the formation of an association along the lines that seemed to be favored by a number of those present. Mr. Dion, however, believed it would be best to let the matter stand over for a time until all the delegates would have a chance of crystallizing their points of view. This would be more readily possible after listening to the discussions.

At a subsequent meeting of the Executive Section following the general discussion, it was decided to make no change in the constitution at the present time.

New Officers

The new officers of the association were elected as follows: president, Col. D. R. Street; first vice-president, Mr. A. L. Mudge; second vice-president, Mr. D. H. McDougal; executive committee, A. A. Dion, R. J. Smith, W. L. Bird, A. E. Dunlop, M.P., W. S. Robertson, R. H. Sperling, W. G. Angus, R. B. McDunnough, L. W. Pratt, H. G. Matthews, F. G. Clark, R. M. Wilson, James Gould and E. L. Milliken. Secretary-treasurer, Mr. H. G. Martin.

The Papers

A brief resume of each of the papers and of the discussions which followed are given below. Future issues of the Electrical News will contain a number of the papers in full.

GRAPHIC METERS

By G. D. Gratton.

This paper outlines the general principles underlying the construction and operation of graphic meters and refers at some length to their operation, maintenance and testing under the following heads: paper or chart speed; scale capacity; performance; repairs and maintenance, cost of operation; testing and records.

The principle of a graphic meter is the same as that of the Kelvin balance, Siemens dynamometer, the Moving Iron, the Induction, and the D'Arsonval instruments. The writer classifies graphic meters under two heads, the relay type and the direct acting type. In the relay type the measuring element does not do the work of operating the pen but closes a set of auxiliary contacts which in turn close the circuit through relay coils that operate the pen. This keeps the pen friction independent of the measuring element and tends towards greater and longer accuracy due partly to the fact that lighter moving elements can be used. Also the instruments do not require so much power to operate them.

In the direct acting type the measuring element operates

the pen directly on the chart so that the moving coils are obliged to have a large torque in order to overcome the pen friction, etc. This means a high shunt loss and in some cases a heavy moving element. In this type it is found that unless the instrument is very carefully adjusted the pen does not follow the fluctuations accurately.

As indicating the relative losses in these two types of meter the paper quotes one make of the direct acting type showing a consumption of 200 watts as compared with another make operating on the relay principle which shows a total loss of only 41 watts.

The speed at which the chart should travel must be determined by the character of the load to be measured and the duration of a peak. A speed of 1½ or 2 in. per hour will suit the majority of cases and will allow a peak of five minutes duration to be scaled off the chart with accuracy.

In determining the scale capacity of a graphic meter it should be so chosen that with the average working position of the pen it will be at least half way across the chart. This tends to greater accuracy in reading and in the case of an alternating current wattmeter would allow it to operate on a load with low power-factor without overloading the current windings and still keep the pointer well up on the scale. A number of examples are given in this connection.

With reference to repairs and maintenance with which the paper deals at length, it is pointed out that a good deal of skill and patience is necessary and that the person undertaking the work should understand the instrument pretty thoroughly. It is not advisable to do extensive repairing except in the repair shop. This applies also to re-calibrating Care must also be taken in shipping and installing these instruments. Figures are given showing the cost of repairs on the different parts, and it is pointed out that the largest item is generally the labor. A number of specific cases of troubles located and their methods of correction are also given.

The cost of operation of these instruments is often considerable, for example, in the case of a direct reading instrument where 200 watts is consumed this would work out at $16.50 a year, supposing energy costs 1c per kw. hour. To this is added the cost of testing and repairs, charts, etc.

The paper deals at length with the methods of testing graphic meters both in the shop and in service. The testing equipment in the shops of the Electric Power Company are illustrated and described and the diagram of the meter testing switchboard is shown. Testing in service generally consists of comparing the readings of the graphic meter with a portable standard type and noting the error.

Discusson

A general discussion followed, in which Mr. Bird, the president, Messrs. Brown, Dion, Kay, O'Donnell, Gratton, Baker and others participated. It was generally conceded that this paper represented what might almost be classed as a hand-book on Graphic Meters and which would prove of the greatest value to operating engineers, inasmuch as the suggestions and statements contained therein were based on the practical experience of the writer. The value of the graphic meter as indicating the actual load conditions under which any company may be working, was emphasized by a number of the speakers. The opinion was expressed, however, that Mr. Gratton's point of view, with reference to the relative current consumption of the two types of meter may not be of such importance as the paper would lead one to suppose. The current consumption in either case was not material and the direct type possesses advantages which may offset the lower operating cost of the relay type. The opinion was expressed that manufacturers should be encouraged to furnish more information regarding the operation and repair of these instruments which were more or less of an enigma to many of the operators. The point brought out in the paper that some convenient device for short circuiting the transformers for testing purposes also met with general approval as did also the description of the system for making tests. One of the speakers, however, thought the system of removing meters for testing would cause unnecessary delay, and that service tests would in general be quite satisfactory. In answer to a question Mr. Gratton stated that they had tried out the printing attachment on their meters and found that it introduced a certain inaccuracy, probably in the enighborhood of from 8 to 12 per cent.

INTEGRATING WATT METERS WITH RECORDING ATTACHMENTS

By S. S. Baker

Mr. Baker classes electric meters for registering peak loads under three headings: integrating meters operating pens which give a continuous record on a paper chart of the momentary values of the power at every instant of time; integrating demand meters which sum up the kilowatt hours over given intervals of time and register the kilowatt hours consumed in each interval; and heavily-damped indicating meters for registering peak loads, whose indications approach the true present value of the power at a rate which is proportional to the difference between the present indication and the present true value of the meter.

A description of a new type of integrating demand meter occupies the greater part of Mr. Baker's paper. In this new meter a Westinghouse watt-hour measuring element is used and the clutch device which operates the recording mechanism is upon a shaft, which rotates once for every hundred revolutions of the meter shaft. The total retarding force of the clutch mechanism amounts to about 2 per cent. of the full load torque of the meter and by compensating for this quite accurate results are obtained under running conditions where the peak load registered is 10 per cent. or more of the full scale deflection of the meter.

On the clutch shaft an electrically released clutch is mounted which remains closed for an interval of one minute. A contact operated by a clock then closes and releases the clutch for a length of time sufficient for the clutch to disengage and be pulled back to the zero position by a spring. The opening of the clock contact again allows the clutch to close and be driven for another minute by the watt-hour element. An arm mounted upon the driven half of this clutch engages a pen mechanism so arranged that the linear deflection of the pen in a direction at right angles to the travel of the paper is proportional to the number of revolutions of the clutch. The deflection of the pen at the expiration of the time element selected for the measurement of the demand therefore measures the kilowatt hours consumed, or, in other words, the "integrated demand" during that interval.

The following advantages are claimed for this meter over ordinary types of the graphic instrument:

(1) Reduced interruptions to meter chart, due to clock and pen trouble.

(2) Increased permanency of calibration.

(3) Increased accuracy in reading of peaks, on account of peaks on chart being perfectly definite.

(4) Reduced maintenance expense.

(5) Determining of peaks on a kw.h. basis.

Discussion

The chief objection raised to this meter appeared to be that inasmuch as most contracts are based on longer peak durations than one minute, theinformation gained by this type of instrument would not possess any particular value for the central station. It was explained, however, by the author, that the cost of such an instrument would not be appreciably greater than the ordinary wattmeter and that the information given would often be of the greatest value to

central stations in that they would have records of their actual operating conditions. The fact was also brought out that many contracts are now based on the average of a number of peaks in which case this type of meter would be particularly useful. The author also explained that though the meter onexhibition indicated only a minute peak, types were also in course of manufacture which would record five minutes or greater if necessary. It was even possible to have attachments so that a meter may be changed from one peak duration to another without any great loss of time. The general opinion seemed to be that the more accurate information given by this new meter would be of great value to the central stations. After the discussion was over the meter was the centre of a group of interested enquirers, to whom Mr. Baker more fully explained the instrument and its usefulness.

ORGANIZATION OF AN APPLIANCE DEPARTMENT

By B. E. Rowley

The paper emphasizes the necessity of fostering a spirit of friendliness and confidence on the part of the customer. Emphasize your attitude by instructing all employees to make a careful note of complaints and see that the proper department follows and adjusts them. Much irritation is caused by hurried answers to complaints either personal or over the telephone, and much can be accomplished if an earnest attempt is made to convince the customer of the friendly attitude of the company and their intention to be square and reasonable in their dealings.

Demonstrations are valuable to illustrate the uses of the various electrical appliances. If you have in your employ a man who can deliver a short address on lighting or other applications of electricity to residences, this can be made supplementary to evening demonstrations. As many prospective customers as possible should be induced to attend these evenings and the talks should not be over their heads. It is not well to cover too much ground in one evening; deal thoroughly with one appliance and speak in a suggestive way of others so as to arouse the curiosity of the listeners.

With reference to the terms of sale the paper takes it for granted that payments will be on the instalment plan. There need be no apprehension about the life of the elements of reputable equipment as these can now be depended upon to outlive their guaranteed age.

Men should be employed in the sales department who show a natural aptitude for that kind of work. Personal appearance, good mental training, youthfulness, etc., are all valuable in this work. Good men often object to canvassing, but this distaste can generally be overcome if the matter is approached in the right way. If the relations between the company and the customer are friendly any employee of the company will generally be welcomed. This is especially so if letters have been sent out previously, announcing that at some early date a representative of the company will call to further explain any matters in which the customer may be interested. It is deemed inadvisable to send a man out with more than one appliance at a time, but he may have photographs and prices of other things with which to arouse the interest of his solicitors. This type of work can be made more attractive to good men in that the company can afford to pay a larger salary. Big money is often made by salesmen working on commission.

It is necessary that salesmen should frequently be called together for an exchange of ideas and experiences. If your salesmen show a tendency to grow stale and to think that there is no more to be learned in the selling business, have a lecturer from some other organization come and give them a short talk and they will soon see that there are still little kinks in the business that they did not know anything about.

Under some circumstances women are the best media of placing appliances before the customers. These can often gain access through telephone appointments where men would have more difficulty.

Special attention is drawn to the value of an attractive office, display of electrical appliances Make this as artistic in appearance as possible and keep everything on it and above it looking fresh and bright. This table will be all the more valuable as many visitors are more likely to purchase when they can pick up an article and examine it without being bothered by a salesman.

A number of forms for use in the appliance sales department are appended.

Discussion

This paper was discussed by Messrs. Pratt, Dion, Magalhaes and others. The question of commission on wattage sales was raised, and it was stated by one of the delegates that it was their custom to pay their solicitors so much per unit. Payment according to wattage sales was scarcely a fair basis in that some appliances which may consume less current were quite as valuable from the central station point of view as others that may consume more current, as for example, if a certain appliance meant the introduction of electricity into a home for the first time. The speakers were unanimous in approving the lessons of energy and initiative in the sale of appliances taught by this paper. It is necessary that we be more aggressive, more systematic and more co-operative to get the best results in commercial sales. This co-operation is necessary between the different branches of the business, including the advertising, the display in the window or on the counter, the salesman, etc. It is well to feature advertising throughout all these departments, all working together on one particular piece of equipment at the same time. In one company it is the custom to have a number of bill boards located at different points of the company's offices, on which is pasted the advertisement appearing in the press for that day. By this means all the departments are given a chance to wor kin unison along the line of this particular advertisement.

THE HYDRO-ELECTRIC RULES AND REGULATIONS AND THE NATIONAL ELECTRIC CODE

By H. F. Strickland

This is a description of the most important points in connection with the new set of wiring rules recently printed and distributed by the Hydro-electric Power Commission of Ontario, and which are to regulate all wiring installations in Ontario. Mr. Strickland pointed out the similarities and differences between the Ontario regulations and the National Code, showing that many repetitions in the National Code had been avoided as well as the many cross references to be found there. However, it is pointed out that the general rules as now printed in the National Code remain practically unaltered so that the manufacturers and dealers in electrical supplies will not be adversely affected.

The writer points out that nowhere on this continent is there a state inspection similar to that now proposed, although there are numerous civic inspection systems, both in the United States and Canada. These however are isolated from one another, and even in the interpretation of the same set of rules there is a very great difference noticeable. This diversity of interpretation of the rules makes it very difficult where contractors are called upon to execute work in different cities.

Under the Power Commission Act every municipality in the province of Ontario must provide a sufficient and proper number of inspectors to enforce the rules adopted, and, owing to the fact that all disputes as to interpretation must be referred to the commission for final adjustment, there will be such uniformity as will be not only of advantage to the

general public, but will also be a great source of satisfaction to all those engaged in the electrical business.

The Hydro rules and regulations have not been drafted with the idea of covering every conceivable form of construction, but with the purpose in view of covering all general inside wiring, such as is met with in every day practice and which any one is liable to be called upon to perform. Prominent among the new rules not found in the National Code are also those necessary for the protection of life. Rules have been introduced in this connection calculated to protect unskilled persons who are liable to inadvertently come in contact with live wires. The paper points out that while it is, of course, impossible to make such installations absolutely fool-proof without placing such restrictions around them as to make their general use impracticable, every effort has been made to so reduce the danger that the use of electricity will, to all intents and purposes, be safe.

The paper cites a number of instances of defective wiring which have come under the personal notice of Mr. Strickland, and which, to the professional man, seem absurd in their glaring carelessness. It is hoped that the new rules under a proper system of inspection and regulation will, in the shortest possible time, remove all these sources of danger.

Discussion

Mr. Strickland's paper came in for considerable criticism, due chiefly to the fact that by the act which gives the Ontario Hydro-electric Power Commission power to create and enforce a set of rules, the same body is made the judge of its own work and at the same time is the final arbiter in any matters of dispute which may arise between a municipality and a private company. Whether this scheme will work out or not in practice remains to be seen. A number of objections and apparent contradictions in the working of the rules were called to the attention of the convention by Mr. Hood, who read a carefully prepared criticism of the situation. Mr. Strickland's reply was to the effect that these rules were tentative in their application, and that as or if they were found unequal to the requirements of the situation they would be changed or amended. It was also pointed out by the author of the paper that this was not intended to be a text book or treatise on the method of making electrical installations, and that little details would have to be worked out in individual cases by getting the inspectors together or by taking up the point at issue by conferences between the inspectors and the municipalities. While the hydro commission would be supreme their power would be used only to see that the inspectors carried out the rules with reasonableness and justice. There was an undeniable general feeling, however, among the convention members, that the inspection department having charge of this work should be a separate organization from the Hydro-electric Power Commission, and if workable, should not even be responsible indirectly to the commission, but rather perhaps to the commission's engineers, or even directly to the government.

UNDERGROUND DISTRIBUTION FOR SMALL CITIES

By S. Bingham Hood

At last year's convention Mr. Hood read a very interesting paper on some of the best types of overhead construction. His paper this year dealt in the same interesting and authoritative way with underground work for smaller cities.

The paper points out that the ordinary conduit system of underground distribution is generally considered too expensive for smaller cities and towns. This is shown by a table of cost data, which states for example, that for an eight duct line, which would be required in a large city system, the duct system represents about 23 per cent. of the total cost, whereas if a four duct line is installed, which is about such as would suit a small city or large town, this figure becomes 70 per cent.

Mr. Hood advocates laying the cable solid in the earth. Cables laid in this way are not subject to any deterioration other than mechanical injury. However, the three core armored cable which is considered good practice on the European continent is not approved by the writer for the following reasons: (1) the jute protection between the armor and the lead sheath will depreciate sooner or later, and leave two dissimilar metals in close proximity, with the inevitable result; (2) in the event of the earthing of the neutral and one outer, the armored sheath will cause an inductive drop which will prevent the other outer being continued in service. The writer advocates the use of a solidly earthed neutral of bare copper in the form of a bond wire around the various earthing points.

This requires only two insulated and lead sheathed single conductor cables for a three-wire system. The combined cost of these and the bare neutral will not exceed the cost of a three-core armored cable and they possess all the advantages of two independent, two-wire systems as to reliability and continuity of service. The method of installation advocated in the paper is to separate each conductor at least 4 in. from the bare neutral, after which the group of cables is covered with from 4 in. to 6 in. of earth and then a cover board of rough lumber laid in for protection.

The paper discusses the different causes resulting in mechanical injury to cables and shows that the kind of installation advocated is not liable to serious or frequent injuries, and quotes an instance where a similar installation has been in operation for over two years under very adverse conditions without causing any trouble whatever.

The latter part of the paper is given up to wiring diagrams, and their explanation, showing various methods of secondary distribution for light and power.

Discussion

The reduced capital expenditure possible by the use of the system outlined by Mr. Hood created a great deal of interest among the delegates and valuable contributions to the discussion were made by Messrs. Angus, Dion, Croucher, Hood, Harris, Marsh, Mudge, Pratt, Hicks and others. Mr. Dion spoke of the situation in Ottawa where it had at first been decided to use the draw-in system, but after mature consideration they had delayed the matter, feeling that the solid system had not been given sufficient thought and that with proper cables, properly laid, this type of underground would probably suit their requirements and at much less expense. The discussion rather tended to disprove Mr. Hood's contention that steel armored cable was apt to give trouble on account of the jute lining between the two metals deteriorating and setting up electrolytic action. This theory did not appear to be borne out by the experience of any of the delegates. Regarding the question of grounding the sheath it was shown to be the pretty general practice to ground everything—the gas pipes, water pipes, sewers, street railway returns, etc. The least trouble resulted when everything was solidly grounded together. It was pointed out by Mr. Mudge that the steel armored cable appeared to be the most satisfactory for 3-phase distribution, but on single-phase, as described by Mr. Hood, there was little doubt that the lead covered type would prove quite satisfactory. In answer to Mr. Pratt's question as to whether this solid system of underground work was flexible enough for growing towns, Mr. Hood replied that it was not. It was only in towns or small cities, on streets that had developed practically to their limit or where the maximum development could be foreseen that this type of distribution could be used with ultimate satisfactory results. This system, Mr. Hood stated,

was quite satisfactory for series distribution, as for example, in the operation of magnetite arcs.

MAGNETITE STREET LIGHTING

By Mr. L. Burpee

This paper first deals briefly with the history of the development of the magnetite arc lamp. The life of the open arc carbon was about sixteen hours. The next step was the enclosed arc with a life of between 100 and 150 hours per trim. The metal electrodes have a still longer life. The upper and positive electrode in the latest type of magnetite arc is made of pure copper; in the 6.6 amp. type the life of this electrode is from 3,000 to 4,000 hours on the average, and about 8,000 hours for the 4 ampere type. The lower and negative electrode is a sheet iron tube filled with magnetic iron, titanium oxide and chromium oxide; the life of the 6.6 amp. electrode averages 125 hours and the 4 amp. type averages 225 hours.

The paper contains distribution curves comparing the 4 ampere magnetite, the 6.6 amp. magnetite, the 6.6 amp. enclosed arc and the 9.6 amp. open arc. These curves, with corresponding figures, show that much better distribution is obtained from the magnetite lamp. The open arc gives maximum intensity of 1250 candle power at 45 deg. below the horizontal and at 15 deg. below only 600 candle power. The maximum of the 4 amp. luminous lamp is 700 c.p. at only 5 deg. below, while that of the 6.6 amp. magnetite is 1625 c.p. at 10 deg. below. The efficiency of the open arc lamps in watts per hemispherical c.p. is exactly equal to that of the 4 amp. magnetite lamp, but the latter gives the same intensity of illumination at 327 feet that the open arc gives at 198 feet, showing the superiority of the magnetite lamp as a street illuminant. The 6.6 amp. magnetite lamp with an energy consumption only slightly greater than that of the open arc gives the same illumination at 510 feet that the open arc lamp gives at 198, which is equivalent to a range of 2.58 times that of the open arc lamp or an area 6.65 times as great. The construction of the magnetite arc lamp is described in detail and its application to ornamental street lighting explained. Comparisons are also made of the light distribution as compared with tungsten clusters consuming the same amount of energy, and it is shown that the ratio between the light given by the arc and the tungsten cluster at different distances works out as follows in favor of the arc lamp:—at 10 ft. 1.95; at 20 ft. 2.5; at 40 ft. 2.7; at 60 ft. 3; at 80 ft. 3.1; at 100 ft. 3.2. The data all goes to shown in a remarkable degree the efficiency of the magnetite lamp as a street illuminant.

The author deals at considerable length with the mercury arc rectifier and states that experience has proven that these now operate under full load with an efficiency of over 99 per cent. and with a life that has reached 16,000 hours.

FLAME CARBON ARC LAMPS

By T. J. Pace

This is a description of the long burning flame carbon lamp recently placed on the market to take the place of the short burning flame lamp, which, on account of its short carbon life was not suitable for street lighting and similar requirements. The new lamp will give an electrode life of from 100 to 125 hours per trim without serious depreciation in light intensity.

By the use of suitable carbons a light of almost any commercial color may be obtained. For street lighting purposes, carbons giving a white light are most generally used, colored lights being confined to display or industrial plant illumination. The yellow light carbons give a considerably higher illumination than the white light carbons.

The efficiency of the new flame lamp is particularly high, being anywhere between 2.5 mean low hemispherical candles per watt with white carbons and alba glassware and 5 candle power per watt with clear glassware. The lamp requires 10 amp., operates with an efficiency of 88 per cent. and a power-factor of 81 per cent.

With the exception of the enclosed carbon lamp this long burning type covers a wider range of application than any of its predecessors. It will operate on series and multiple alternating current and direct current circuits and in multiple series on direct current power circuits. Also by the use of a self-contained or external auto-transformer, individual a.c. constant current lamps may be placed on an existing circuit of a different current value. This scheme is frequently resorted to when it is desired to increase the illumination at certain points, as for example, at prominent street corners.

This lamp also operates on frequencies as low as 25 cycles, though there is a slight decrease of light at each reversal due to the cooling of the arc gases. This is not considered objectionable under most conditions.

The paper gives some camparative figures of the carbon and trimming costs of the old short burning flame carbon and the new long burning flame lamp, placing the yearly expense of the former at \$56.60, and of the latter at \$7.78. It is also pointed out that there is an additional saving of time due to less frequent suspension of work in order to retrim the lamps.

Figures are also given, showing the relative operating costs per year of 4,000 hours, of four different types of lamps in use to-day for street lighting purposes. The a.c. series enclosed carbon type consuming 6.6 amps., costs \$25.42, to operate; the new flame carbon series lamp consuming 10 amp., costs \$35.23; the metallic flame lamp using 4 amperes, costs \$24.49, and the metallic flame lamp using 6.6 amp., costs \$36.55. A number of illustrations of the lamp are also given.

Discussions

The papers on the luminous arc lamp and the new flame carbon arc lamp were both illustrated by lantern slides comparing in a number of cases the illumination of certain streets during the day and at night time, to the apparent advantage of the night illumination. The discussion showed that a number of the delegates had had favorable experience with these two types of lamp. As an example of comparison between the five-light oranmental tungsten cluster and the magnetite arc, for example, the case of Calgary was quoted where two adjacent streets, located in such a position that they may be observed from the same point, are said to show up the magnetites to particularly good advantage. Another speaker drew attention to a Buffalo installation, where, under similar circumstances, the arc also gives the more favorable results. Most of the speakers dwelt on the value of the illumination of the buildings, stating that in many cases they knew of, all the details of the architectural design were more clearly brought out at night than even during broad daylight. In this connection it was intimated that the growing use of electric signs might, in this way, be rendered unnecessary. The statement was made that even at the present time installations of ornamental clusters are being replaced by arc lamps, as being more efficient in operation, and as giving a better distribution; this is especially the case where there are no trees to block the light rays so that the source of illumination may be placed 16 or 18 feet above the sidewalk. The inherent difference between the two types of lamp described in these two papers is that the magnetite will only operate on direct current while the carbon will operate on either alternating and direct, and on a cycle as low as 25. In answer to a question by Mr. Hastings, Mr Burpee stated that the rectified 25 cycle current did not show any tendency to flicker.

ELECTRICITY ON THE FARM

By Jno. C. Parker

The paper draws attention to the value of the farm load as a means of extending the off-peak demands on the central station. The company with which Mr. Parker is associated are making a thorough investigation of the requirements of the case and have one man detailed to do nothing else but study the possibilities of farm electrical applications.

The cost of the installation has been one of the most difficult features. Farmers are loath to spend much money on equipment which they operate only a few minutes every day, and the writer is of the opinion that it would be better to install less expensive equipment even at the cost of higher current charges. He bears out this opinion by figures which go to show that current costs represent only a small percentage of the total cost of operation, in some cases as low as 6 or 7 per cent. On this basis it is evident that if the cost of reliable equipment can be lowered considerably the actual expense of the energy will not be a serious obstacle in the way of extending the application of electricity much more generally to farms.

Mr. Parker also objects very strongly to the type of literature often distributed in this connection, showing for example, a woman in a conventional evening dress gazing pensively at a luminous radiator, or the house-wife reading a novel while the washing machine is being electrically driven, etc. He recognizes that the average farmer does not approve of these tactics and certainly will not spend very much money to create such a condition. The literature must be made much more real and sane. Such advertising as the above tends to create the impression that farms must be electrified for sentimental rather than industrial reasons, which is entirely wrong.

The paper gets at the kernel of the situation in stating that the value of electricity on the farm is in its solution of the labor problem. It is not that the electric motor will develop more energy at $1.50 per day than will the average farm laborer, but that the electric motor can be induced to stay on the farm and be ready for work when it is wanted, which the farm laborer cannot. Year by year the matter of securing even indifferent, unintelligent and unskilled farm help becomes harder and harder. The electric motor is not merely a device for supplanting man power, but for freeing the farmer from his dependence on the man at all. In other words, electricity on the farm will be—when it comes to its own—a solution of one of the social problems in farm economics.

The paper suggests a new application of the use of electricity on the farm in the pruning of orchards. This is to be done in the same method as trees are now sometimes felled by electricity. Not only would this do the work neatly and quickly, but it would close the wound at the same time.

The writer places the blame for the slow advance in the use of electricity on the farm on the central station men who have not been sufficiently aggressive in following up this kind of load. The farm business is going to be worth cultivating. The farmers are going to use more energy than at present seems possible. In the meantime it will help if the costs of the wiring installations and the electrical equipments are kept down to the lowest possible figure.

Discussion

Mr. Parker interpolated the different points in his paper with a number of interesting explanatory side talks, emphasizing even more strongly than his paper had originally done, the value of the farmer as a customer for the central station and the possibilities in the way of the central station making itself useful to the farmer. The point was emphasized that the central station must come to have the farmers' point of view as well as his own so that he may be able to supply the needs of the case in the quickest and most economical way. Mr. Parker believed that at the present time the necessary activities of the farmer covered too wide a field, ranging from that of a specialist on the one hand to the work of a mere laborer on the other. He believed that by the introduction of electricity the manual part of the requirements might be taken off his hands which would leave the farmer more time and energy to devote to the scientific development of his chosen pursuit. The speaker believed there is a great field ahead in the way of intensive farming when the value of the crop yield will be greatly increased by scientific treatment copuled with careful and business-like methods of gathering and disposing of the crops.

Interesting remarks were made by Mr. Peeling and Mr. McLellan, of the Electric Power Company. Mr. McLellan is the one man in this company who has come more closely in touch with the farmer than probably anyone else in Canada, and he was able to outline in a very practical way the difficulties met with and the results likely to be obtained from a further pursuit of this kind of business. M. McLellan also was equally hopeful that in the very near future when the farmer can be brought to understand the advantages of the use of electricity and whe nthe cost of the initial installation can be reduced somewhat and made sufficiently rugged that it requires practically no technical attention, the business of farm supply can be very greatly increased. A detailed account of what the Electric Power Company is actually doing in the Trent Valley Canal appeared in the June 1 issue of the Electrical News.

THE ELECTRIC VEHICLE

By Stephen G. Thompson

Although there is ample field for the use of the electric pleasure vehicle the probability of its general adoption appears remote at the present time on account of the relatively high first, cost as compared with the gasoline machine. With the electric power wagon, however, the case is entirely different owing to the utility features of this vehicle. On every hand electric vehicle installations are now to be found where the investment values are of such magnitude as to indicate that the selection of this type could only have been made after exhaustive investigations. The very fact that electric vehicles have not been peddled and that they have practically sold themselves on their own merits, is the strongest argument in favor of their becoming very generally used in the near future.

This paper points out that the requirements of a city service are not so efficiently filled by a gasoline machine as by the electric. Frequent starts and stops reduce the speed of the gasoline below that of the electric and it is a fact borne out by figures given in the paper, that the actual speed of the electric machine is greater, through the crowded streets, than that of a gasoline truck. These figures go to show that in one test covering a triangular course the electric vehicle made the distance at an average speed of 9.65 miles per hour as compared with 8.48 miles per hour for the gas machine, and in test No. 2, also over a triangular course the electric's time averaged 10.03 miles per hour as against 9.48 for gasoline. This was in spite of the fact that the electric vehicle was geared to a maximum speed of only twelve miles per hour while the gasoline was geared up to eighteen miles.

Another point brought out in the paper is the relatively lower cost of maintenance of the electric. Figures are given which show that the average cost per car mile for maintenance of the electric truck increased only 13 1-3 per cent. in tests covering 69 machines over a period of four years. The cost of maintenance of the gasoline increased 362½ per cent. in 54 machines over the same time. The figures show that the average maintenance cost per car mile for the electric machine after seven months operation was 7.5c and after 48

months operation was 8.5c. The figures for the gas car under the same conditions were respectively 4c and 18c.

ELECTRIC VEHICLES FROM THE CENTRAL STATION POINT OF VIEW

By C. Rummel

This paper describes the electric vehicle situation in Vancouver particularly, and to some extent at other points in British Columbia. The B. C. E. R. Company had been forced into handling electric trucks because locally these were being sold by agents who were equally interested in gas cars and who naturally followed the line of least resistance. In the interests of the industry therefore, the company had deemed it best to, itself take charge of the supply of electric trucks in Vancouver and neighborhood.

At the very outset the company engaged an electric vehicle expert with ripe experience, both in selling and garaging. The industry was advertised extensively in the daily press, pointing out the advantages of electric trucks. This was followed up by an active personal canvas, follow-up letters, etc. One very effective method of advertising used was to offer the service of one of the company's trucks to reliable "prospects" for an ordinary day's delivery of the firm; such an illustration would give the merchant the best proof of the value of the truck in his particular line of business.

The paper outlines the various types of truck and the number at present in operation in and around Vancouver. The prospects are reported as very numerous, and already there are a large number of satisfied customers.

As a necessary supplement to the use of the electric vehicle, this company had found it advisable to establish an electric garage with a charging outfit of 45 kw. capacity, and a schedule of rates has been established as follows: for a 750 lb. capacity, $45 per month; 1000 lbs. capacity, $45 per month; 2,000 lbs. capacity, $55 per month; 4,000 lbs. capacity, $60 per month; 7,000 lbs. capacity, $65 per month; 10,000 lbs. capacity, $70. These charges cover the current supply, storage of the vehicle, washing and oiling and the making of minor adjustments.

The paper reports that in both Vancouver and Victoria a number of private garages are equipped with charging outfits, and the company also plans to maintain charging equipment at different central points within its territory.

Mr. Rummel concludes by pointing out the great advantage of the electric vehicle load to the central station man. He also raises the question of the almost prohibitive price of the electric truck. There is no question about the economical operation of the electric truck when the rates that can now be offered by the central station are taken into consideration, and the next move should therefore be on the part of the manufacturers, to produce a vehicle at a more reasonable cost.

Discussions

The two papers dealing with electric vehicles provoked a lengthy and valuable discussion to which contributions were made by Messrs. McBurney, Dion, Keyes, Lambe, Merritt, Oborne, Hillman, Maclachlan, LaChapelle, Magalhaes, President Bird and others. The opinion was expressed that the cost of electric vehicles as given in Mr. Rummel's paper was higher than the figures obtaining in many cities in Canada. Above, say, the two-ton capacity truck, the cost of the electric vehicle was not appreciably different from that of the gas truck. The probable reason that below this capacity the figures showed a greater discrepancy could be accounted for by the fact that the low capacity gasoline so-called trucks were not in reality trucks at all, but were for the most part truck bodies laid on a passenger chassis, whereas electric trucks of this capacity were built on the truck principle. Actual figures brought forward by a number of the speakers showed that the discrepancy in costs was far from being as large as is generally supposed. Taking into consideration the longer life of the electric and its lower operating costs, it can even now be shown that the electric is well to the fore in the competition between the two kinds of trucks. Certainly with a reduced initial cost which must come with more general use, it will be no uneven competition in the very near future.

In respect to cost of operation a number of very valuable facts were brought out. Mr. Dion suggested that where it was mentioned that the increase in operating costs per car mile was from 4c to 18c for a gas car it must also be taken into consideration that this would inevitably be accompanied by many interruptions in the service. On the other hand the fact that the electric operating costs only increased by a few per cent. indicated a continuity of service that was highly satisfactory. Some examples of actual operating costs were given by a number of the members present. One stated that the current costs for their one truck amounted to 1.8c per mile for current with a total of 6c per mile operating expenses, this being taken the year round as the car was operating throughout severe winter conditions. As another example of the splendid showing made by electrics the cost of operating two 3½ ton trucks and two 5-ton trucks by a brewing company was stated to be about $30 for all per month, for current; whereas the gasoline alone for each of these trucks would cost in the neighborhood of the same amount per month. This operating cost worked out at about 1c per mile for current alone.

Of the equipment for charging, motor generators were considered the most satisfactory. With the conditions under which private garages operate mercury rectifiers these were not found to work out as satisfactorily, largely on account of lack in the necessary attention required by this equipment.

Some startling figures were given as to the revenue derivable from this kind of load. It was stated by one of the speakers that while they do not make any special rate for this kind of load they find that the income per kilowatt of demand works out to something like five times as much as that resulting from any other kind of commercial load, including motors, household equipment, etc., etc., obtainable by the average central station. When it is considered that the central station has almost absolute control of this load charging the batteries at a time when his energy cannot be used for any other purpose, this must be considered as a clear gain. Many companies in the United States and in Canada are at present in receipt of many thousands of dollars annually, therefore, practically without the expenditure of any additional capital.

The attitude of the speakers was rather an opposition to the idea of the central station constituting itself a sales agent for the exploitation of electric vehicles. It was considered the best policy to leave this in the hands of the ordinary agents and co-operate with these in every possible way. A number of the companies do operate a public garage where they charge batteries for trucks and pleasure vehicles and in a few cases attend to repairs, but only in so far as it is found necessary to do this in order to encourage the industry, and increase the station load, would it be a justifiable proceeding.

Storage batteries are evidently standing up well under the conditions as encountered in the various cities in Canada. In Montreal where it was intimated that the roads are about as bad as are usually found, the results were quite satisfactory. Some forms of battery would stand low temperatures better than others, but if the necessary precautions were taken to protect the battery from cold, it was found that these would operate through the winter under con-

ditions in which gas cars had proved a failure. No instance was related by any of the speakers where it had been necessary to set aside their cars during our severe winter weather either because the batteries were unsuitable or because any other part of the car would not stand the severe conditions. The reports in this connection were surprisingly encouraging.

The president summed up the discussion by saying that it was evident no central station could make any mistake in following up the matter of electric vehicle exploitation as vigorously as possible.

SERVICE

By Stephen L. Coles

This paper emphasizes the self-evident proposition that, where the public is being served, it is necessary to keep prominently in mind that that service should be the best possible. This is especially true in the central station business where they come more intimately in touch with the consumer than is the case in any other line of business, in that they supply light, heat and power to the home, the store, the office, the hospital, the theatre, the factory, and frequently for transportation. The most valuable asset a central station can possess is the good will of the public it serves. Nothing that enters into service or has any bearing upon it should be considered trivial. That central station manager more nearly approaches the ideal of service, who keeps his eye on the little details of his business. The paper finally draws attention to the fact that every point of contact between the company and a customer is an opportunity for service. The manner in which any such opportunity is grasped is an exact demonstration of the company's ability to give service.

Discussion

The keynote of the discussion which followed the reading of this paper was the outstanding value of a prompt and courteous service. It had until recently, been considered that a low rate was the most important consideration in going after a prospective customer's business, but it had been shown that this was now a matter of secondary consideration and in certain cases where competition was keen, as for example, between a municipality and a private company, the latter were often able to demand a higher price for their current owing to the fact that they gave a better service. Considering that the cost of current is a comparatively small percentage of the total cost of operating any manufacturing concern this point of view could easily be made to carry weight with the consumer.

A number of the companies maintain an emergency department night and day in connection with which skilled operators are available at a few minutes notice. As a general thing it is not the custom to make extensive repairs, this being considered the province of the electrical contractor, but where the customer is going to be inconvenienced by delay, it was considered good policy on the part of the company to do everything in their power to make repairs so as to relieve the customer from any unnecessary discomfort. The necessity of advertising in the daily papers was considered for the most part essential even if the company happened to be operating in a town where there was no competition. It kept the consumer in touch with the source of supply and got him into the way of feeling that the central station was thinking about him and thinking about his interests. While it may not be, strictly speaking, the function of a supply station to maintain a department to search for troubles which occur in the installations made by electrical contractors it is often the best policy to do so partly from the fact that the electrical contractor is not available on the spur of the moment and that he rarely carries a sufficient force of operators to attend to emergency calls, while on the other hand the company's office was accessible at all times. For sentimental reasons, too, it was of value to the central station that the consumer should get into the habit of looking to them for assistance. Troubles properly attended to with the utmost speed even at a considerable expense often introduced friendly relations between the customer and the central station which resulted advantageously to the latter in the increase of their business.

CENTRAL STATION ADVERTISING

By D. H. McDougall

The various methods of advertising are divided into two classes:

(1) By direct contact with the public.

(2) By printed advertisements.

And in connection with the latter it is necessary

(1) That the advertisement must be read.

(2) The advertisement must be true.

The first division of advertising (direct contact), and the most important, is divided into

(1) Delivery of the goods.

(2) Courtesy to the public at every point of contact.

(3) Direct personal canvas.

(4) Periodical visits to consumers to solicit criticism and forestal complaints.

(5) Prompt and cheerful attention to complaints of customers by means of an efficient emergency force.

The author considers that the direct method of advertising is undoubtedly the best. Every employee of the company is a medium for advertising the company. He should be courteous and efficient, which characteristics, next to the actual delivery of goods, are the best method of advertising the company's business. This is true of every employee whether telephone operator, complaint clerk, demonstrator, billing clerk, office boy, or delivery man. Especially the complaint department is one of the most important branches of the business and the company should select with the greatest care the men who handle the complaints.

Under the heading of printed advertising the following classification is given in the order of considered importance.

(1) Direct advertising such as company magazines, circulars, letters, pamphlets, etc.

(2) Daily newspaper advertisements.

(3) Bill board, street car and electric signs.

(4) Weekly papers and magazines.

(5) Theatre programmes, etc.

Mr. McDougall considers the best of these is a properly prepared company magazine. Through this medium it is possible to supply a great amount of elementary information which attracts the reader and puts him in the way of doing business with the company. The value of newspaper advertising depends very much on the attitude of the press, as a large advertisement can easily be neutralized by a small antagonistic editorial. Of the other methods of advertising, namely, bill boards, street car and electric signs, the sign is placed first, but it is thought that these are better adapted to advertising manufacturers' articles. It is also suggested that dignity is lacking in many of the modern signs.

The paper concludes by again emphasizing the advertising value of good service which means delivering the goods in every branch of the organization with efficiency and courtesy.

POLE TYPE TRANSFORMERS

By C. T. Sisson

This paper discusses some of the more important details entering into the design and construction of the modern lighting transformer both from the operators' and manufacturers' view point. The essential features of the lighting transformer are safety, durability, economy of operation

and first cost, these being dependent largely upon the following factors: insulation, ageing, temperature rise, core loss, copper loss, regulation and magnetizing current.

Safety depends chiefly upon the insulation between the high tension and the low tension and core or ground and this should receive prime consideration.

Durability, which is dependent upon the life of the insulation, is also a matter of supreme importance. The manufacturer has perhaps not taken as much notice of this quality as of efficiency or low operating cost, but it is now a matter of consideration with most consumers what the length of life of his transformer is going to be. Durability, or what is almost the same thing, reliability, is dependent on the best arrangement of parts and the selection of the most suitable methods of insulating. The paper discusses the methods of insulation very generally used, the chief object to be kept in view being that the insulating material must be kept free from moisture and be as little affected by changes in temperature as possible.

Marked improvements in the quality of steel and the adoption of more economical designs have reduced the cost of operation greatly in the last few years. Also a decided improvement has been made in the regulation at low power-factors. Indeed the improvements would justify replacing many of the old type transformers with the later and more efficient designs.

Mr. Sisson favors the plan of having each central station test every piece of apparatus placed on the system. This is a check on the manufacturer as well as that it gives the operator a complete knowledge of the construction of the apparatus. Any difficulties resulting from handling or shipping will also be noted. The tests suggested on a transformer include insulation tests, measurement of core loss and exciting current, measurement of resistance, measurement of impedance, tests for heating and ratio and polarity tests.

The paper does not hold out any hope that the efficiency of transformers will be greatly improved with later developments. Efficiency of the better transformers now stands at from 97 to 98.5 per cent. It is predicted that the developments will rather be along the line of lengthening the age of the transformer.

CONVENTION NOTES

Three hundred delegates and guests registered.

Mr. T. C. Martin, secretary of the National Electric Light Association was an interested listener at a number of the sessions.

The Toronto Railway Company granted free transportation to all the C. E. A. delegates and visitors wearing badges. This thoughtful consideration was much appreciated by all.

The "Cabaret" on the evening of the second day of the convention attracted upwards of 300 of the beauty and chivalry of the attending delegates. The supper was good, the program, though purely amateur, a most excellent one, and the dance, as usual, a proper ending to a good day.

The theatre party on the evening of the first day of the convention attracted delegates to the number of 300. "Green Stockings" was thoroughly enjoyed by everybody, but the "hit" of the evening was the neat little speech by Miss Percy Haswell herself, in which she gave recognition to the great value of electricity in enhancing the beauty of her stage presentations.

The ladies, to the number of fifty or sixty, enjoyed a three-hour motor trip around the city on Thursday morning, viewing many points of interest and finally bringing up at the Royal Canadian Yacht Club wharf. Afterwards luncheon was served at the club's Island pavilion. The motor trip was possible through the kindness of a number of members of the association who loaned their machines for the purpose and in many cases themselves acted as guides to the party.

The Sons of Jove held a most successful rejuvenation in the Temple Building on Friday evening at which a number of prominent central station men were initiated into the mysteries of this order. It is claimed this was the most successful rejuvenation that has yet been held in Toronto, and that in point of elaborate preparation and artistic effect it has been unsurpassed by few, if any, cities on the continent.

The baseball match between the central stations and the manufacturers, while never in doubt as to the outcome, was nevertheless keenly contested. The final score of 11 to 4 in favor of the central stations, may be taken as a fair indication of the relative merits of the two teams. The score might easily have been higher had it not been that a couple of the members of the winning team have been a little slow in rounding into condition this season.

Trade Publications

Public Utilities Report—The first report of the Manitoba Public Utilities Commission covering the six months ending November 30th, 1912, is just to hand.

Pneumatic Tools—Bulletin No. 127 by the Chicago Pneumatic Tool Company, describing pneumatic drills, reamers, wood borers, flue rolling and tapping machines and grinders.

Refillable Fuses—A card issued by the A. F. Daum Company, Pittsburgh, illustrating the development of refillable fuses for electric light and power circuits. These fuses are illustrated in structure, appearance and finish.

Cleat Receptacles—A booklet issued by the Canadian General Electric Company, descriptive of Norbitt cleat receptacles and rosettes, and Crouse-Hinds temporary decorative sockets.

Indirect Lighting—A pamphlet issued by the National X-Ray Reflector Company, dealing with the origin and development of indirect lighting, including an explanation of what he calls "the semi-indirect fallacy," by Augustus D. Curtis.

Catechism on a.c. Apparatus—As a companion book to "Catechism on Direct Current Apparatus" Fairbanks-Morse & Company, of Chicago, have recently issued a catechism on alternating current apparatus. This booklet deals with the construction and application of generators, motors and auxiliary equipment, in which the writer has succeeded in giving in a condensed "question and answer" form, a very great amount of practical information. A glossary covering a large number of electrical terms used in ordinary practice is appended.

Electric Vehicles—The Westinghouse Electric & Manufacturing Company have issued leaflet No. 3679, describing electric vehicle battery switchboards and motor-generator sets. Special mention is made of the sectional switchboard, which has proven very satisfactory for this class of work, to enable additions to be made from time to time, at slight expense. Another folder, No. 4255, describes Westinghouse type PG porcelain insulators. These are insulators with high mechanical strength suitable for use on 1500 volt d.c. railway work and 2200 volt transmission lines.

Rail Bonds—The Electric Service Supplies Company have just issued their 1913 catalogue on "Protected Rail Bonds and Appliances." The catalogue is well illustrated, and besides showing every practicable type of rail bond it illustrates clearly the value of proper installation, the importance of accurate testing apparatus, and the use of bond compressors. This company report that their factory has been working night and day for several months to meet the demand for Keystone steel gear cases, and Garton-Daniels lightning arresters, in connection with which all indications point to a record-breaking year in the sales department.

The New C.P.R. Shops at Ogden

The Canadian Pacific Railway Company have recently put in operation near Calgary a large shop plant of unusual interest by reason of its size, its complete and modern character and the speed with which it was created. The work was designed and built in its entirety by Westinghouse, Church, Kerr & Company, consulting and constructing engineers, of Montreal and New York, working under the direction of Mr. J. G. Sullivan, Chief Engineer of the western lines of the C. P. R., and Mr. N. E. Brooks, Division Engineer.

The shop location is at Ogden (named in honor of Mr. I. G. Ogden, vice-president of the company), 4½ miles from Calgary. Its distance from those sections of the country where the greater part of the construction materials, machinery and equipments were obtainable, constituted one of the most important problems. A second problem arose on account of the construction season being extremely short owing to the high latitude, frost remaining in the ground until about April 1st, and returning with snow as early as October 1st. Labor is also comparatively scarce at this point, especially in the late summer months during harvesting operations. When it is pointed out that the ground was not broken until April 1, 1912, and that the locomotive shop was in full operation on March 17th, 1913, it will be appreciated that a record for prompt performance was established.

The shops consist in general of the main locomotive shop, including erecting, machine, blacksmith and boiler shops; tender and wheel shop; pattern shop and pattern storage; foundry; store house and office building; material platforms and scrap dock; oil house, coach repair and paint shop; freight car repair shop, planing mill, boiler and compressor house; 1260 ft. yard crane and miscellaneous structures, including transfer table and pit for coach shop, mess hall, driven wells, water tower and all service systems, such as drainage, sewage, fire protection, water supply, etc.

Electrical equipment has been used wherever practicable in these shops. Power is supplied by the Calgary Power Company by one 2300 volt, 3-phase, 60 cycle, 2000 kw. feeder for normal service and one 2300 volt, 3-phase, 60 cycle, 1000 kw. feeder for breakdown service. This power is transformed and distributed from two sub-stations, one of which is located in the boiler house and the other adjacent to and immediately outside of the low machine bay in the locomotive shop. The equipment of the sub-station near the locomotive shop consists of three 75-kw., 2300/230/150 volt lighting transformers; three 200 kw., 2300/600 volt power transformers; and two 300-h.p., 2300 volt, 60 cycle, 3-phase motor generator sets for the 250 volt d.c. power and a twelve panel switchboard. The high tension bus series and potential transformers and auto-transformers for motor generator sets are mounted on the wall at rear of switchboard. The electrolytic lightning arresters are mounted on a special gallery in the corner of the sub-station.

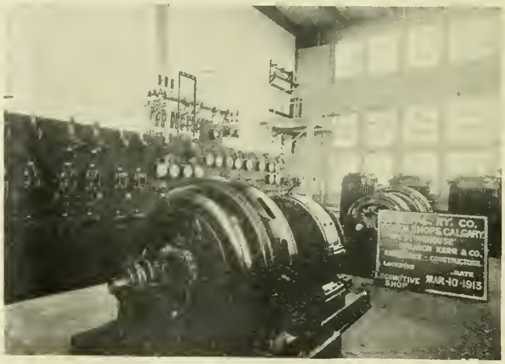
This board distributes 250 volt d.c. current for all crane and hoist service and variable speed motors driving individual machine tools; 600 volts, 3-phase, 60 cycle current for constant speed motors for line shafting and individual drive machines, and 230/115 volt three-wire single phase current for lighting, for the locomotive shop, tender shop, foundry, storehouse, pattern shop, oil house and adjacent small buildings.

The equipment of the sub-station in the boiler house consists of two 37½ kw. 2300/230/115 volt lighting transformers, three 100 kw. 2300/600 volt power transformers and an eight-panel switchboard. This board distributes 230/115 volt, single phase, three wire lighting current and 600 volt, 3-phase, 60 cycle power current for the boiler house, planing mill, freight car shop, coach shop and adjacent small buildings; also 600 volt, 3-phase, 60 cycle current for general yard lighting. This board also controls the two 325 h.p., 2300 volt, 3-phase, 60 cycle induction motors operating the air compressors which are located in the sub-station. These compressors supply all air required for shop service and pneumatic tools.

The main feeders from the sub-station supplying the locomotive shop are carried across the centre of the shop in an underground duct system. Feeder panels are located at each bay, and control overhead feeders running the entire length of the shop which supply the different distributing panels. These distributing panels furnish all current necessary for shop operation and, where possible, the circuits to machines are carried in conduit beneath the floor, thereby minimizing the amount of exposed wire in the shops. In the other shop buildings all feeders are run overhead.

The entire area of the erecting shop is served by two travelling cranes carried on two levels, (a) a 120-ton crane furnished with two sixty-ton trolleys is carried on the upper level and is used for transferring, wheeling and unwheeling locomotives and handling parts; one of the trolleys in this crane is equipped with a 10-ton auxiliary hoist for handling light material at a high hoisting speed and (b) a 10-ton travelling electric crane operates at high speed and serves the entire area of the erecting shop for handling material and transferring same to the blacksmith and machine shops.

The machine shop is supplied with a high speed 10-ton crane which covers the entire area of this shop, 778 ft. x



C.P.R. locomotive shop sub-station, Ogden.

60 ft. in size. Material is brought to the door of this shop by a travelling electric yard crane.

The boiler shop is provided with a 40-ton travelling electric crane equipped with two 20-ton trolleys serving the entire area of the boiler shop for handling the boilers and other material. A 25-ton electrically-operated crane for serving the hydraulic rivetter is erected in a special tower in the bay between the boiler and blacksmith shop. In one of the bays of the boiler shop space is provided for a flue shop and the boiler shop tools. The entire length of this space is served by a 3-ton overhead travelling trolley.

The general illumination consists of Cooper-Hewitt lamps with circuit and plug boxes for extension lamp cords. Provision has also been made for incandescent lighting circuits for individual lighting at machine tools where required, and for outlet boxes for connecting extension lamp cords to provide lighting for the interior of the locomotive boilers on the erecting floor.

The tender and wheel shop is spanned over its entire area by a 20-ton high speed travelling electric crane equipped with two 10-ton trolleys. An electrically-operated car puller is installed for hauling the equipment into and out of the

shop. The lighting is similar to that described above for the main locomotive shop.

The foundry building is served over its entire length by a 10-ton high speed travelling electric crane. An electric elevator is provided for handling material when changing cupels. For general illumination flaming arc lamps are used in the high bay and open arcs in the low bay with outlet boxes for extension lamp cords. This building is located along side and parallel with the travelling electric yard crane, which facilitates the handling of castings from foundry to storage, to the locomotive shop, or for shipment.

The storehouse and office building contains an electric elevator, Carbon and tungsten lamps are used for lighting. The storehouse is located parallel with the main locomotive shop and the space between these two buildings is spanned by a high speed 10-ton travelling electric crane which can be utilized to handle all heavy material to and from the cars. This crane is provided with a 43-in. lifting magnet to facilitate the handling of material.

A 150-ton electrically-operated transfer table is provided for serving the coach repair shop. Tungsten and carbon lamps are used for illumination of the coach repair and paint shop, oil house and pattern shop, and also for mess house and miscellaneous small buildings in the yard. Flaming arcs are used for general yard illumination. Mercury vapor lamps are used for lighting in the planing mill, and the boiler house is lighted with arc and incandescent lamps.

The boiler house contains 2100 h.p. water tube boilers divided into three batteries of two units of 350 h.p. each. Five of the boilers are equipped with chain grate stokers. The sixth boiler has shaking grates to burn shavings and other planing mill refuse. A motor-driven pivot steel elevator raises the coal and discharges it into the overhead bunkers. A skip bucket with electric hoist handles the ashes into the ash bin. Space is provided for three electrically-driven air compressors with a capacity of 1500 cubic feet per minute, two of which are installed at present.

All buildings are heated to a temperature of 60 deg. with an outside temperature of 30 deg. below zero. This is accomplished in the larger buildings by the indirect blower system, underground ducts of concrete and tile being used to distribute the air in most cases. All blowers are direct connected to horizontal throttling engines, the engine exhaust being carried to the indirect heaters. Seventy-seven thousand five hundred square feet of cast iron indirect heating surface was installed for this work. In some of the small buildings where ventilation was not a prime requisite, direct radiation was used for heating. All buildings are equipped with air, water and steam lines where such service is necessary. A complete system for fire protection has been installed in the buildings and yard, and two 8-in. wells have been driven and equipped with electrically operated pumps for supplying the necessary water for all shop purposes.

Robb Boiler Contracts

Robb water tube boilers are being built at the International Engineering Works Limited, Amherst, N.S., for the Picton County Electric Company, Stellarton, N.S.; Ottawa Gas Company, Ottawa, Ont.; and the Inverness Railway & Coal Company, Inverness, N.S. The International Engineering Works have recently sold horizontal return tubular boilers to the following companies: St. Lawrence Pulp & Lumber Company, Pabos Mills, P.Q.; N. S. Clay Works, Halifax, N.S.; Maritime Coal, Railway & Power Company, Joggins, N.S.; Record Foundry & Machine Company, Moncton, N.B., and the Rocky Mountain Cement Company, Blairmore, Alta.

Oil Switches

By W. A. Coates, A.M.I.E.E.

In a recent article on the protection of electrical circuits, attention was drawn to the necessity for employing switches of ample capacity to handle not only the known normal load of the circuit, but also the possible emergency load due to heavy "shorts" on the distribution side of the switch. The present article is intended to deal more fully with this question.

When a switch opens an arc is formed which, roughly, may be said to be "long" in proportion to the voltage across the arc and "fat" or heavy in proportion to the current passing. Theoretically, an oil switch will rupture the circuit at the instant the voltage wave is passing through the zero point, but in actual practice this is rarely the case, the arc re-building as the voltage rises on the other side of the zero line. The arc itself consists of vaporised oil and metal, which is a much better conductor than oil. A further consideration to be taken into account is the possibility of voltage surges at the moment of switching, which would assist to rebuild the arc.

It will therefore be seen that the length of break must be at least so great as to ensure the final rupture of the arc in spite of the above conditions.

European and especially German practice, seems to be to keep the length of break down near this limit, but both American and English manufacturers employ breaks far greater than are demanded by the above limitations. This is made clear by a study of oscillograph records in conjunction with the switch "Break-time" curves. At the same time this apparently unnecessary length of break is quite a useful feature in increasing the "breaking-capacity" of a switch, as will be seen later.

A more important point, and one very rarely appreciated at its full value, is the effect of a "fat" arc. Even assuming that the current is finally interrupted in the first alternation, the heat generated in that period by its passage through the resistance of the oil and metal vapour, must be dealt with. Bearing in mind that heating effects are proportional to the square of the current, it will be realized that this is a very serious factor. This heat is dissipated in part by direct conduction to the metal contacts. Plenty of metal in the contacts is therefore a distinct advantage. The more important effect, however, is the instantaneous vaporisation of the oil adjacent to the contacts. This may give rise to dangerous pressures in the oil tank. More than one case is on record where the pressure in the tank reached a figure of 100-140 lbs. per square inch.

Again it must be borne in mind that a mixture of oil vapour and air is explosive and sufficient oil must be provided above the contacts to prevent the arc reaching the air above, and to cool the vaporised oil sufficiently to prevent all risk of spontaneous combustion. The most recent designs, both in America and England, embody large air spaces above the surface of the oil, which act as cushions in the event of explosion or violent disturbance of the oil. This air space is confined in a case sufficiently strong to withstand any possible explosive force, and generally a vent tube is provided to lead the products of combustion away from the switch cubicle.

It will be realized that an exceptionally heavy arc might possibly reach to the tank itself, thus grounding the system. To obviate this risk a baffle of some fireproof insulating material should be used to line the tank, being so arranged as to leave a layer of quiescent oil between it and the metal. This layer of oil should be thick enough to withstand at least double the normal voltage between line and earth.

The question of insulators is now pretty well standardized, as porcelain is almost universally employed on moderate voltages. Mica, moulded under great pressure, has been

used with great success in England. It has much to recommend it on the score of mechanical strength, and when moulded in this way, it is entirely unaffected by oil. For the higher voltages the condenser type of terminal is not only neater, but lends itself much better to sound mechanical design than does the oil filled type of bushing.

References was made above to possible recurrence of the arc due to surge voltages. This phenomenon more frequently gives trouble, however, in breaking down insulation. Especially on small switches it is by no means uncommon to find excellent precautions to prevent arcing from phase to phase, under oil, while the terminals immediately above the tank are brought so close together as to invite trouble. On switches having an ultimate capacity of 10,000 kv.a. and over the practice of employing single pole units linked together by a common operating mechanism is almost universal. In these cases grounding trouble is all that need be anticipated and guarded against.

From the above remarks it will be seen that the suitability of a switch for a given service depends not only on its ampere and voltage capacity but also on its emergency kv.a. capacity. This last function depends on:—

(a) Length of break.
(b) Head of oil above arcing point.
(c) Volume of air above oil level.
(d) Volume of oil surrounding contacts.
(e) Strength of tank and air chamber to resist internal explosion.
(f) Thickness of quiescent wall of oil inside tank.
(g) Weight of metal in contacts.

All these points must be considered when comparing the merits of different switches, in addition to the more obvious points, such as sturdy construction, sound mechanical design and suitable main and arcing contacts. In connection with this matter of emergency capacity, the author would suggest that all manufacturers should establish a convention to rate switches, firstly, by their normal kv.a. capacity, i.e., normal amperes and normal volts, and secondly, by the kv.a. the switch will actually interrupt under emergency without other damage than burnt arcing contacts.

A vast deal of trouble is caused by makers stating the capacity of a switch in so many kv.a. of plant, when it is quite obvious that the plant capacity alone means nothing. What the switch will do is the point, and is the guarantee which is most frequently avoided. In these days the big switch gear firms at least, have had quite enough experience to enable them to give a guarantee that means something definite.

When discussing this subject the writer has frequently been asked how to determine what emergency kv.a. capacity will be required. A few cases will therefore be considered.

With a simple system, wherein a single set of bus-bars is used, to which all generators are connected and from which all feeders run, any switch on the main board may be called upon to break the short circuit current of the whole generating plant in parallel. As is generally known, this figure may rise as high as 20 times normal full load current for a brief period, but will settle down to about three times normal full load, which figure will be maintained as long as the prime movers hold up. Some firms make a practice of increasing the plant capacity of switches which have a definite time lag in operation, assuming that operation is delayed until the peak overload has died down. In view of the fact that the current rush will usually settle down in about .05 seconds, while the switch will not start to move in less than .1 second, it would seem to be a somewhat dangerous policy to make this rule a universal one.

The case of converters or motor-generators working in parallel with the main generating plant, and taking supply from some other source of power, occurs but rarely in this country. The former type of machine is capable of maintaining about eight times normal full load, while the motor-generator set would act as a simple generator at first, but would quickly settle down to possibly 1½ times normal full load. The insertion of a length of feeder or of transformers between the generators and the switch will, of course, limit the possible emergency kv.a. which can flow. In the case of feeders no general rule can be given, but it may be taken that modern transformers, unless specially designed to have high impedance, will permit 8 to 10 times normal kv.a. to pass. Some authorities place this figure down at 3 to 4 times normal, but this seems altogether too low. In any case it is clear that the necessary kv.a. capacity indicated in this way need never be greater than would be the case if no transformers were present.

On the larger plants it is not unusual to break up the busbar system into several independent sections and in this case the total generating capacity behind each section is all that need be considered. This also holds good if the busbars are linked by automatic group switches, but if non-automatic switches are used to link the bars the case must be considered as one with a simple bus-bar system.

In place of automatic group switches, or in addition thereto, current limiting reactances in the bus-bars have found much favor of late years. Undoubtedly these devices are of the utmost value in preventing the heavy rushes of current consequent upon short circuits, but their great size makes them awkward to build into the structure, which has to be abnormally large in consequence.

In the writer's opinion the better way to deal with the problem of handling exceptionally large powers is to employ switches having leading contacts which insert a limiting resistance before actually breaking circuit.

Australian Telephones

The telephone systems throughout the Commonwealth are administered by the Postal Department. The extension of the telephone service in Australia is making rapid progress by direct lines and through the adaptation of telegraph wires for telephonic purposes by means of the condenser. The government is spending large amounts from year to year in new equipment and the construction of lines. At the end of 1911, there were throughout the Commonwealth 85,458 telephone lines connected to 927 exchanges. The number of instruments connected was 102,654, giving 2.25 per cent. of instruments to the population.

The cost of the instruments installed and the connections made are (unless in exceptional circumstances) defrayed by the Postmaster General's department. Formerly a specific rate was charged for the hire and connection of a telephone which entitled any subscriber to an unlimited number of calls. In recent years the annual charge was reduced (in some of the states by over 50 per cent) and a further charge is now made for each effective call. Immediately the annual subscription was reduced the demand for telephones—especially for private houses—increased to such an extent that the department was unable to cope with the requirements. The charges for a telephone connection throughout Australia are as follows:—

Population	Radius with main exchange miles	Minimum Annual Charge: For an exclusive service	Two party service	Three or more party service
From 1 to 10,000	5	$15.00	$12.50	$10.00
From 10,001 to 100,000 ..	10	17.50	13.75	11.25
From 100,001 upwards ..	10	20.00	15.00	12.50

For all effective calls, subscribers are charged the following additional rates:—

For calls not exceeding 2,000 half-yearly one cent each.

For calls above 2,000 half-yearly, three calls for two cents.

No charge will be made to the subscriber for calls received by him.

The Mystery of an Overcharge

A Story of Fact That Reads Like Fiction—By an Illuminating Engineer

Some years ago, a large shoe concern built a new factory. The factory was to be up-to-date in every way. The architect introduced every kind of improvement he knew of, but, as usual, neglected to give the electric lighting any attention whatever. All that he required off the contractor was, "that lights should be placed where necesary." When the time came around to do the wiring, etc., it was given to the plumber who did the piping, "to be done on time and stock." After events proved beyond all dispute that the plumber was no lighting expert, but credit should be given where credit is due. I have never known another man who had such a faculty for installing incandescent lights like that plumber. He placed lights in all sorts of places—dozens of them. On one sewing machine table, with ten operators, he put twenty-five 16 candle power lamps. In the sewing room which is 56 ft. x 72 ft. he put 164 cord drops five feet from the floor all equipped with 16 candle power lamps, besides 4 old type enclosed arc lamps. The rest of the building was wired in a similar manner. The total load of the building immediately after the plumber had finished was: 632 16 candle power lamps, at 60 watts each, approximately 38 kw.; 4 enclosed arc lamps at 2 kw.; making a total of 40 kw., approximately at 7 cents per kw.h.

The building was opened in November, 1908. The employees worked from 7.30 a.m. to 6 p.m. There was an average amount of daylight. On December 6th the power company presented their first bill from November 3rd to December 1st, twenty-four working days, the amount was $246.81. The company was flabergasted! They sent for the plumber, but the plumber could do nothing. "They'd better take it up with the power company."

They wrote to the power company asking them to test their meter as the amount charged for one month's burning was out of all proportions. The Power Company advised them that the meter was a new one, just from the manufacturer, and bore the Government seal. They were therefore released from all blame for the overcharge.

Time went on—their bills increased every month in the winter time—until March, when it reached the $400 mark. The company grew desperate. They wrote to the Power Company again and asked them to make a test on the meter at their expense. This was done. The Government issued a certificate saying that the meter was 4 per cent. slow on low load and 2½ per cent. high on high load which was allowed by law. The meter went back and the Power Company washed its hands of all responsibility.

In April, 1910, they called in the Big Fixture Company and asked them to go over the building and see what was wrong, and make recommendations to remedy the defects. The Big Fixture Company reported that in their opinion the carbon lamps ought to be changed for new ones. The "T.H." base sockets should be changed to Edison base, and more switches should be installed, this also was done, but the consumption still remained excessive.

In October, 1910, I received a letter from the company stating their case. They wanted to know if I had any record of the cost of lighting another factory about the same size. I referred them to The Blank Glove Company, who had more space and more employees than they had, and whose yearly bill was less than $1,000. Much correspondence ensued. In December they left the case in my hands. All the carbon lamps were removed. In the sewing room 46 60 watt tungsten lamps with "armoured" steel reflectors replaced the old system of 164 16 candle power lamps. The former load was approximately 10 kw.; the new load was less than 3 kw. In the remainder of the rooms 101 Aston Radiant Lanterns with 100 watt tungsten lamps replaced the balance of the 632 16 candle power lamps and 4 enclosed arc lamps.

The ammeter showed 354 amperes on the old load and 124 amperes on the new load, a difference of nearly two-thirds. In December, 1908, the lighting bill was $310.68, for the same month 1909 it was $322.14. After the changes were made, the cost for the month of December was $163.

Needless to say the company was pleased with the results, but even this amount was high, it figured out at nearly $2,000 per year. Yet the load was 10 per cent. less than that of The Blank Glove Company, whose conditions and rate were the same. Somewhere there must be something wrong. Although we were at loss to ascertain the cause of it. The lamps were of the best make. We took care to allow no wastage of light. The meter was tested and sealed by the Government. They refused to make another test. Yet there were enough indications that the meter was registering wrong to devote my time to that instrument.

In January we bought a new meter of the same type and size. This meter also bore the Government seal. It was installed alongside of the old one. On January 24th the old meter registered 4441 kw.h., the new meter registered 2230 kw.h. Here was the whole trouble. The old meter was wrong. It was registering 2 to 1.

We wrote to the Power Company and told them that we were in a position to state definitely that their meter was registering twice as much current as we consumed and we were billed accordingly. We therefore claimed a rebate of 50 per cent. on all lighting bills paid since 1908 when the present meter was installed.

The Power Company advised us that our claim was too unusual for them to consider, and that our contention that their meter was registering 2 to 1 was ridiculous, such a thing was unknown. The meter was 4 per cent. fast as stated by the Government. They ended up by reminding us of their previous letter which stated that they had no further interest in the case. Arbitration followed. After much correspondence it was agreed that a board of three engineers should decide whether the meter was wrong or not.

In the presence of the Power Company's engineer, the manufacturer's inspector and myself the troublesome instrument was removed to the labotory. There we tested out a 60 watt Osram lamp with a lamp tester it showed exactly 60 watts, connected up with our meter for 30 minutes it showed 59 watts or 118 watts per hour. Our case looked good! We made one more test. A 500 watt heater registered 490 watts in 30 minutes. Our claim was accepted. The meter went back to the Government testing laboratory where it was dismounted, and although we were not advised officially what the trouble was, yet I have heard privately that a ten ampere clockwork had been installed in a 5 ampere meter. The dial was the usual 5 ampere size. The clock work twice its size, hence, the double registering.

As I have stated our claim was accepted. The Power Company handed us back one-half of the total we had paid for light in two years, which amounted to many hundred dollars.

I have in my possession two invoices from the Power Company to the shoe company. One is for light from January 31st to February 28th, 1909, $470.69. The other is for the same month 1910, with three days more burning, from January 29th to March 3rd, $99.90, which is entirely due to an up-to-date lighting system and a correct meter.

This case like many others I know of proves beyond question that a well-lighted building costs less to maintain than a poorly-lighted one.

Testing of Telephone and Telegraph Lines*

A Series of Short Articles Based on the Author's Practical Knowledge and Experience—Applicable to Plant of Any Size or to Any Manufacturer's Equipment

By Mr. T. H. Nicholson

There is a large variety of instruments available that are more or less suitable for telephone and telegraph testing, and it is often difficult for prospective users to know what type is best suited for individual needs and different conditions. Those most generally used may be classified under three general heads, viz., voltmeters, simple Wheatstone bridges and the so-called portable test sets. For rough testing of known troubles, and for routine tests, the voltmeter is by far the best, for the reason that it is self-indicating under certain limitations and it can be arranged with suitable keys to permit of rapid testing. For the actual location of line troubles, however, it is necessary to have some form of Wheatstone bridge, unless a very elaborate arrangement of the voltmeter is permissible, for, as will be later shown, the accuracy of the instrument is only sufficient when connected to a circuit of approximately its own resistance. This, of course, can be accomplished by noting the resistance, as indicated on normal circuits, and cutting into the voltmeter a coil which will shunt it down to that resistance and then taking the corrected reading on the scale calibrated for that particular shunt.

It would be necessary to have a shunt and associated scale for each division of about ten volts, and as such an arrangement would be more trouble than a regular bridge it is rarely so used. Where economy is of great importance a simple bridge can be made up from standard resistance boxes, using the voltmeter with the extra resistance added to the moving coil cut-out for a galvanometer, and even where a regular form of Wheatstone bridge is used this course is recommended. The preliminary test is made with a voltmeter substituted for the regular galvanometer, and when an approximation has been reached the galvanometer is cut back into circuit and the bridge again adjusted to the finer sensibility of this instrument. This method has the advantage of allowing quick testing without the danger of damaging the galvanometer by the excessive currents that might occur on the preliminary tests.

A very convenient form of Wheatstone bridge has recently been developed by several manufacturers, called a "faultfinder" or "ohmmeter." With this instrument it is only necessary to revolve a handle or a knob until a balance is reached, and the corresponding resistance is then indicated directly, thus dispensing with the work of noting and figuring out the various arm values. In some of these instruments the necessary switches are included to arrange the bridge for the various tests usually used, and a table is provided which gives the corresponding values for each test from the figures on the dial. These instruments are rapidly coming into favor on account of their simplicity of operation and flexibility of use.

For measurements on long trunk or toll lines a more elaborate style of bridge is advisable to obtain the accuracy necessary on large gauge wire of considerable length. Like the faultfinder, these instruments are made up in sets that include switches for making the various tests desired, and are generally similar excepting that the operations of the arm units are independent of one another.

For locating trouble in cables preliminary to opening, a still higher grade of instrument is necessary. There is now on the market a wide range of instruments for this work which will be more fully described when that subject is dealt with.

In order to appreciate the reason for the several arrangements of testing circuits it is necessary to know the fundamental principles of the instrument used, so a digression will now be advisable to explain these principles.

The Wheatstone Bridge.

The Wheatstone bridge is the most important instrument used in testing, and a thorough understanding of the principles of its operation will make the explanation of the various tests made with it of greater value. There is no method of measuring resistance directly, any more than there is a method of measuring friction in mechanics, which is an analogous condition, so it is necesasry to compare the effects of the resistance to be measured with similar effects on a known resistance. The most suitable arrangement of resistances for this purpose was first recognized by Christie, but it is to Sir Charles Wheatstone that we owe its development into practical form, hence the name. Fig. 4 shows in conventional form the arrangement of a Wheatstone bridge. A. & B. are two ratio arms, either of which may be made

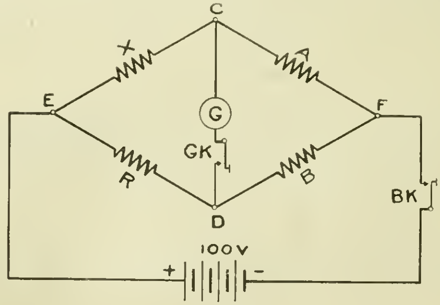


Fig. 4.

10, 100 or 1000 (or combination of these) ohms resistance; R is a rheostat or plug top; X, unknown resistance to be measured; G, galvanometer or voltmeter; BK, battery key; GK galvanometer key.

The Wheatstone bridge is based on the principle that no deflection of the galvanometer will be noted when no difference of potential exists between the points C and D. This condition can only exist when the ratio between X and R is the same as the ratio between A and B. If then A and B are made equal (whether 10, 100 or 1000 ohms is immaterial) and the resistance of R is varied so that we get no deflection of G on depressing the keys (except a temporary deflection which shows the presence of capacity or impendance) we know that the unknown resistance X is the same as R. Similarly if we make B ten times as large or one-tenth as large as A, we know that when we get a balance, the resistance at R is ten times as large or one-tenth as large as X, as the case may be. This latter feature of changing the relative values of A and B is either for the purpose of measuring values of X which are larger than the capacity of R or else of measuring closer than the nearest whole number.

For example: If X is 15792 we make B, 10 or 100 and A 100 or 1000, that is, B is one-tenth of A. A balance will then

be obtained (approximately) when 1579 is unplugged in R. In this case an exact balance cannot be obtained since 1579 really corresponds to 15790 in X and 1580 to 15800, a difference of 10 in the true value. The only thing to do in this case is to note the deflection to one side with 1579 out and also the deflection to the other side with 1580 out. If they are equal in degree the true value would be half way between 15790 and 15800. If one is smaller than the other, then the resistance which gives the small deflection is the one to use and the true value would have to be estimated as between 15790 and 15795.

If it was desired to measure a resistance very closely, say 15.79, then the ratio of A and B would be reversed, so that A is one-tenth of B. A balance will then be obtained when 1579 is unplugged and, since A is one-tenth of B, the unknown resistance will be one-tenth of R or 15.79. The explanation of the foregoing is as follows:—

Assuming the set-up as shown in Fig. 4, and both battery and galvanometer keys closed, there will be a flow of current from positive battery to (E), where it will divide, part passing by way of X and A to (F), and part by way of R and B to (F), where the two will unite again and return to battery. The strength of current in these two branches will vary inversely with the resistance, but in this case we are not concerned with the actual current strength but rather with the voltage drop in the different parts of the circuit.

Neglecting the resistance of the leads, the voltage between (E) and (F) will be the same as that of the battery, say 100 volts. If now we consider the XA part of the circuit we may conceive of part of the energy or voltage used up in forcing the current as far as (C) leaving the balance to be used in sending the current through the rest of the distance to (F). Thus, if X and A are equal, 50 volts would be required in each part of the circuit. Similarly in the RB part of the circuit, if the two parts are equal, there will be just half the voltage required in each part. Therefore if X equals A and R equals B there will be a drop of 50 volts in either circuit at (C) and (D) and no difference of potential will exist between these points.

The same argument will hold if we assume X to be one-third of A and R to be one-third of B. There would then be the same proportionate drop in voltage in the two circuits, with again no difference of potential between (C) and (D). This being the case we will get no deflection on the galvanometer. It will thus be seen that it is not the actual resistance of the four arms of the bridge, nor yet the fact that X equals A and R equals B that gives a balanced galvanometer, but simply the fact that X bears the same relation to A that R does to B.

This may be expressed thus: $X : A = R : B$
or by the rules of proportion $X : R = A : B$.

It should also be noted in this connection that any resistance which may exist in the battery circuit has no effect on the proportions of the bridge arms, a fact which is made use of in locating grounds and side crosses by the Varley or Murray tests as later described. Neither does it matter what resistance exists in the galvanometer circuit, except that added resistance necessarily reduces the sensibility of the instrument, but this feature is of great value when it is desirable to use a more rugged instrument than that ordinarily used.

The Wheatstone bridge is made in a number of forms, all of which produce the same results as outlined above. The oldest forms is that in which the A, B and R arms are suitable sets of resistance coils connected through some kind of switches in series. This form of bridge was originated by the telegraph department of the British Post Office, and for that reason is generally known as the Post Office or P. O. bridge. A serious drawback exists in this bridge, however, that of the multiplicity of contacts through which the measurement must be made, and this led to the development of the decade type which is now generally considered as the standard arrangement by all makers. In this type the bridge arms are made up of coils all connected at one side to a common conductor, and the other side to a switching device for connecting through. By this means only such coils as are in use have a contact point, and trouble from poor contact is much reduced. Another type of bridge is the so-called slide wire instrument in which the usual variable coil is replaced by one of fixed value, and the A and B arms replaced by one continuous piece of uniform resistance wire. A slider connected to the current supply is moved along the wire until a balance is obtained, and the proportion of wire on one side of the slider to that on the other gives the proportion of the fixed coil to the unknown resistance.

Telephone Extensions in British Columbia

Apart from the large amount of construction necessary to complete the new circuits to Victoria, via Nanaimo, the plant department of the B. C. Telephone Company has considerable work on hand in different portions of the territory in which it operates. The estimate has been approved for the placing of aerial cables, poles and wire in Edmonds and the Burnaby Lake district. This will be connected up to the New Westminster exchange. A 19-gauge cable will be extended out of New Westminster, taking in the district around Deer Lake also. The work is extensive, involving a large expenditure and will not be completed before September, though subscribers' stations will be cut in as progress is made.

A general relief estimate for the whole of the Collingwood territory is in hand, and poles will be placed along the principal thoroughfares in the district.

Laying the duct for the extensions in the West End of Vancouver is now almost completed, and the cable to be installed underground is being manufactured by the Imperial Wire and Cable Company, Montreal. This work will take another month.

In Victoria an extension is being made to the underground system on Pandora avenue, between Belmont street and Verrinder avenue to connect with the present underground system on Fort street. Another extensive piece of work is the removal of two copper circuits now extending over the Sooke Hills, between Victoria and Cobble Hill, and transferring them to the Saanich Peninsula. Owing to the altitude of the route of the line, interruption to traffic has always been threatened, especially in winter when snow lies deep on the hills. Transferring the line will assure an almost continuous service between Victoria and points north on Vancouver Island, as well as with Vancouver.

Fifty additional trunk lines are to be provided in Vancouver by the B. C. Telephone Company between the downtown exchange at Seymour and the Bayview exchange in Fairview. These will be in addition to the large number of inter-office trunk lines, provision for which was made some time ago. With increasing traffic additional facilities are necessary.

Vancouver, on the peninsula between Burrard Inlet and False Creek, is connected with Vancouver south of False Creek by means of a 350-pair sub-marine cable at Granville street, four 200-pair aerial cables at Main street, as well as by other wires on the wholly land section east of False Creek. When the separate exchanges were established at Fairmont and Bayview, one of the 200 pair cables at Cambie street was left unused. It will now be utilized to supply the extra service required at Bayview and also to the new headquarters of the plant department, the building for which on Front street is about half constructed. This structure will be six storeys in height, but even at that will be none too large.

Electric Railways

New Rolling Stock for St. Thomas

The St. Thomas municipal railway system recently placed in service three new double-truck pre-payment cars built by the G. C. Kuhlman Car Company. The cars are illustrated herewith.

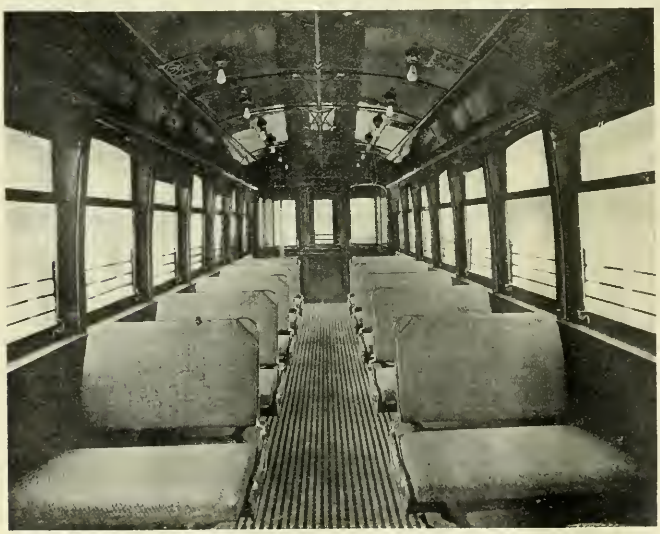
The new cars are mounted on Brill No. 39-E single-motor trucks, having solid forged side frames and pedestal jaws that are integral with the forgings. A steel bottom frame supports the upper structure, in which the ash corner posts are 3⅝ in. and side posts 3¼ in. thick. Eight exhaust ventilators are placed in the Brill plain-arch roof. The roof is supported on ash carlines, reinforced with concealed steel rafters.

There are two prepayment platforms, 6 ft. 6 in. long, separated from the body by bulkheads. Each bulkhead has two sliding doors, with a common central pocket. The car's are arranged for double-end operation, and, therefore, each platform has an entrance and two exits. The combined entrance and exit at the left of the motorman's position is divided by a door post, shown in the accompanying engraving; behind this is another post, reaching from the floor to the hood, and a pipe railing, fixed to this post, extends back to the conductor's position. The openings are fitted with a two-leaf folding door post. A folding step operates in conjunction with the entrance door and on the other side is a sliding exit door and synchronous folding step, operated by the motorman.

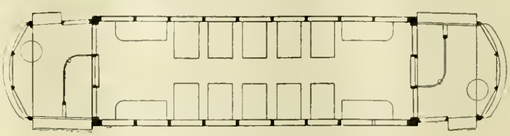
The cars are equipped with the Brill semi-convertible window system, in which both sashes, when raised, disappear in roof pockets. The seating arrangement provides for 28 passengers, of whom 20 occupy Brill "Winner" reversible seats, and eight longitudinal corner seats. The roofs are ceiled with three-ply birch veneer and the sides and bulkheads are cherry, rubbed to a smooth, dull finish. Push buttons are provided for signaling motorman and conductor. Sand boxes, alarm gongs, signal bells and other accessories are of the builder's manufacture.

The specifications of the cars follow: Length over corner posts, 25 ft. 4 in.; length over platforms, 38 ft. 4 in.; length of platforms, 6 ft. 6 in.; centers of side posts, 2 ft. 8 in.; width over sills, 8 ft. 6 in.; width over posts, 8 ft. 6¾ in.; extreme width, 8 ft. 8¾ in.; from side sills over trolley boards, 8 ft. 11⅝ in.; track to step, 15 7/16 in.; from floor to center of headlining, 7 ft. 10¼ in.; step to platform, 14½ in.; platform to floor, 9⅜ in.; seating capacity, 28, type of trucks, Brill No. 39-E; wheel base, 4 ft. 6 in.; diameter of wheels, 33 and 21 in.; weight of carbody, less electrical equipment, 27,380 lb. weight of trucks, 9,560 lb.

Exterior new St. Thomas cars.



Interior new St. Thomas cars—seating capacity 28.

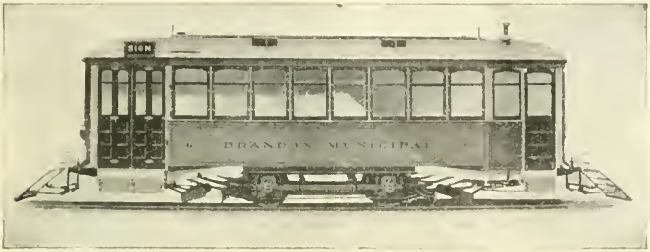


Plan of new St, Thomas cars.

Brandon Municipal Railway System

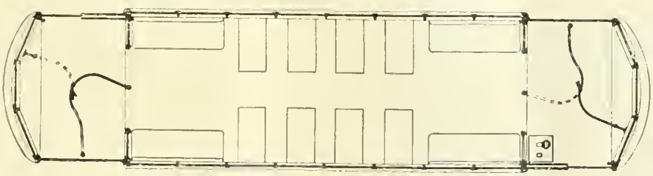
The municipality of the city of Brandon, Man., are just putting the finishing touches to their electric railway system, and expect to be operating part of their rolling stock within the next few weeks. The car bodies are being manufactured by the Niles Car & Manufacturing Company of Cleveland. The trucks are Brill manufacture with 8 foot wheel base and 33 in. rolled steel wheels on 4½ in. A. E. R. A. axles. Five of the ten cars which compose the initial order will be equipped with G.E. No. 80-A motors and five with Westinghouse No. 101-B equipments. Each end of the cars is fitted with an eclipse type fender.

These cars are novel in that they are built with steel underframe and plate trusses extending from the truck to the window sills. This frame consists of two 5 in. steel I beams, full length of the body, which rest directly on the truck frames and are bolted to them. The cross sills are of 4 in. steel channels resting directly on the longitudinal I beams and riveted to them with steel plate gussets. The side sills are of steel angles, 3½ in. x 2½ in. with the short leg resting directly on the ends of the cross sills and riveted to them with steel gussets. The side wall is of ⅛ in. steel plates riveted to the side sills at the bottom and the steel belt rail 2½ in. x ⅜ in. at the top.



Showing one of Cars on Brandon's New Municipal System.

The platforms are 6 feet in length and supported on steel angles and channels from the end sills of 8 in. steel channels.



Plan of Brandon's new street cars.

The right side of the rear vestibule and the left side of the front vestibule are fitted with two pairs of two panel folding doors, with folding steps automatically connected to the doors which are manually operated from the conductor's station only. The right side of the front vestibule and the left side of the rear vestibule have single sliding doors with automatic folding steps, also under manual control and operated from the motorman's station only. Each platform is fitted with reversible iron pipe railings which separate incoming and outgoing passengers and isolate the motorman from passengers at the front end as shown in the accompanying floor plan.

The single arch roof is fitted with four automatic ventilators, having inside ceiling registers. Over each entrance door is a novel combined sign and light for the vestibule. That is, the vestibule lamp is placed in the sign box over the door so that it not only illuminates the sign but also lights the steps and vestibule.

The Brandon municipal electric railway system has been placed under the management of Mr. J. Antonisen, former city engineer of Moose Jaw. The construction stages of the work were in charge of Mr. Bert Greenway.

Crouse-Hinds Unit Resistance

The Resistance illustrated herewith embodies many new and improved features in the construction of Headlight resistance. It consists of a sheet steel frame, removable side plates, end hubs, hangers, resistance units and the various parts required to insure perfect insulation and circuit connections. Its design and construction is such that a damaged resistance unit can be easily and quickly replaced without removing the resistance from the car or disturbing any of the undamaged resistance units. This form of construction eliminates the possibility of damage to the resistance units through leakage from resistance wire to the metal housing. The resistance wire will not rust and is non-corrosive. It can be used in any climate without deterioration and is not affected by moisture. Furthermore, it will withstand extreme high temperature without oxidizing, scaling or becoming brittle.

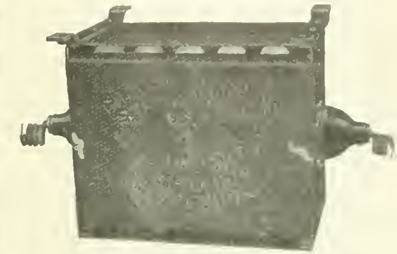


Fig. 1.—Removable Unit Resistance, Complete.

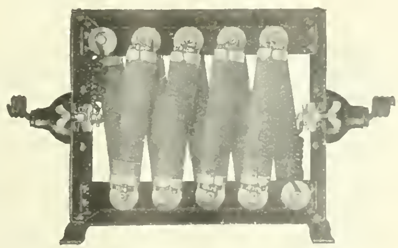


Fig. 2.—Removable Unit Resistance, with side plates removed.

The time involved in repairing is reduced to a minimum as, after one or both of the side plates have been removed, Fig. 2, the defective units are readily detected and new ones substituted, without taking the resistance apart. A unit is easily removed by loosening the connecting nuts that clamp it at each end. The resistance is adapted to either open or conduit wiring, as the end hubs, in addition to being tapped for ½-inch conduit, are provided with bushings, which can be removed easily. This equipment has been devised by the Crouse-Hinds Company and is now being placed on the Canadian market by the Crouse-Hinds Company of Canada, Ltd.

Illumination

Proper Gymnasium Lighting

Gymnasium activities are largely carried on by artificial illumination, especially in Y. M. C. A. organizations and the playground parks of our large cities. The benefits of the exercise will therefore be in a very direct way proportional to the satisfactory character of the lighting system employed. Instructors of gymnasium classes are in a position to judge good and bad lighting, to observe its influence upon the spirit of the game, and its tendency to produce fatigue as a result of eye strain.

The man in charge of the gymnasium illustrated herewith said that since improving the lighting conditions, the boys are livelier, take a newer interest in their play and enter into the contests with much more spirit. Before the new lighting units were installed, misplays in many of the games were very frequent. The cause of this is directly traceable to the poor lighting conditions since the open lamps were blinding and the poor distribution of light caused an indistinctness of objects used in the play. Good lighting has increased ocular comfort, seeing power and accuracy.

There are several playground park gymnasiums operated under the supervision of the West Chicago Park Commission, and as an example the men's gymnasium of Holstein Park is illustrated, Fig. 1. This gymnasium is 36 ft. wide and 60 ft. long with a balcony at one end projecting about 8 feet into the room. The general arrangement of lighting units as indicated by the plan, Fig. 4. and section Fig. 2 shows twelve outlets 20 ft. above the floor and about 8 feet from the side wall. X-Ray Bee Hive reflectors, Fig. 3, which, as shown, are enclosed in coarse wire baskets, Fig. 5, provide perfect illumination for the room. With one 150 watt lamp for each reflector the total wattage is 1800 or .83 watts per square foot. The particular reflector installed comes down well over the lamp and thus shields the filament from view, preventing glare.

The interior view of this gymnasium brings out several interesting points. The photograph was taken by the

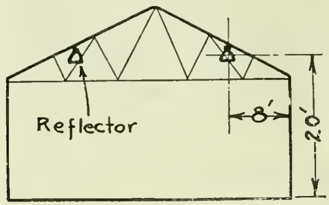


Fig. 2


Fig. 3

artificial light only, no flash lighting being employed, and those familiar with photographic processes will readily appreciate that a comparatively long exposure is required under artificial lighting, to bring out distinctly the dark walls and apparatus. The clear definition of detail indicates that there is plenty of light in the room and that it is properly and evenly distributed. It will be noted also in the photograph that there is a remarkable absence of halation or glare about the units. This is accounted for only by the fact that a direct view of the lamps is almost entirely cut off by the


Fig 1.—A properly illuminated gymnasium

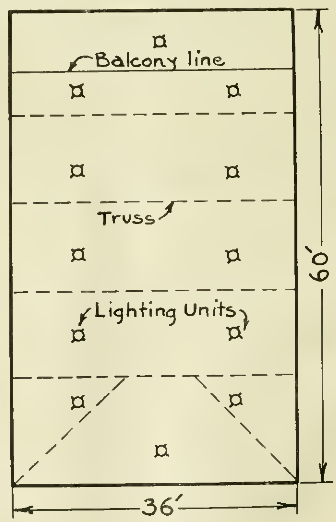


Fig. 4

deep reflector. Bare lamps or partially shaded lamps would appear in the picture as glaring lumps of light.

The wire guards mentioned above protect the reflector from damage by balls and swinging apparatus, and their presence does not affect the lighting results. The guards are constructed of No. 10 wire and are circular in form, they are very substantial and rigid. The fastening of the guard is independent of the reflector support. This practice will prevent any vibration or jar, due to striking of the wire, being transmitted to the lamps and reflector. The basket

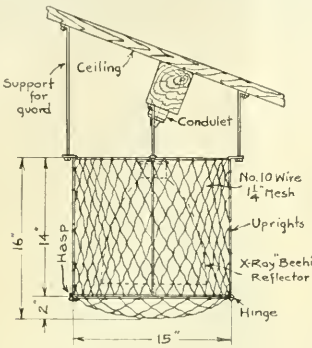


Fig. 5

protectors of this installation are repeatedly hit by basket balls and indoor base balls, but no breakage of lamps or wire protector can be opened, thus making the lamps and reflectors easy of access for cleaning and renewals.

The Bee Hive type of reflector has been adopted by the West Park Board of Chicago, after trying out several types of units, and in eight of the playground gymnasiums this reflector replaces systems which used four lamps bunched at the outlet. A saving in wattage has resulted and also a very large increase in the effective illumination. The eight gymnasiums are practically duplicates of each other so that the above description is equally applicable to all.

Personals

Mr. H. E. M. Kensit, who has for some time past been attached to the Water Power Branch of the Department of the Interior, has now been appointed city commissioner at Prince Albert, Saskatchewan.

Mr. W. E. Goring, assistant sales manager for the Hamilton Electric Light & Power Company, represented his company at the annual convention of the National Electric Light Association held in Chicago, June 2nd to June 6th.

Mr. Thomas Ahearn, president of the Ottawa Electric Railway and Ottawa Electric Companies, accompanied by Mr. James D. Fraser, secretary treasurer of the former company, and Judge D. B. MacTavish of Ottawa, sailed June 24th for Liverpool. Mr. Ahearn is taking his own motor car, and with Mr. Fraser and Judge MacTavish will motor through the United Kingdom. They will return home about the middle of August.

Mr. John S. MacLean has been appointed to take charge of the publicity and advertising work of the Canadian General Electric Company, Limited, and of the Canadian Allis-Chalmers, Limited, with headquarters in Toronto. The latter company in addition to manufacturing an extensive line of machinery and appliances will also act as sales agents for all the products of the Canada Foundry Company, Limited. Mr. MacLean held a similar position with Allis-Chalmers-Bullock, Limited, for a number of years.

Mr. R. H. Nichols, Canadian representative of Messrs. Evershed & Vignoles, Limited, of Acton Lane Works, London, Eng., has just returned from a two months' business trip in England. He reports that business generally is very brisk and as evidence of this his principals have been compelled to double the size of their plant within the last two years and are still extending. In the Megger department alone they had over four hundred instruments on order as well as having in hand the work of providing the electrical instruments for at least six of H. M. battleships now in course of construction.

Mr. Arthur S. Herbert has resigned his position as general manager of the Siemens Company of Canada, and has been appointed general manager of the branch offices of the Siemens Company in Australia. Mr. Herbert is now in England, but will return to Canada for a few weeks early in July, sailing for Australia from Vancouver about the end of August. He will be succeeded in Canada by Mr. C. A. Ablett, whose name has been closely associated with the electrification of rolling mills in Europe during the past few years, and who recently made a brief investigation of the position of the large steel works of Canada with regard to electric drive. Mr. Ablett will take up his duties in Canada early in July.

Mr. P. T. Davies, the first president of the Montreal Electrical Society, was on Saturday, June 21st, presented, on behalf of the members, by Mr. T. H. Nicholson, the new president, with a gold watch fob. The presentation was on the occasion of the society's first summer visit to the Mount Royal tunnel of the C. N. R. The fob is inscribed with the society's emblem. Mr. Davies was born in South Wales in 1882, and after a private education, began his business career with the Uskide Engineering Company, Newport, Mo. Later he joined the staff of the South Wales Electric Power Distribution Company, and in 1907 came to Canada, entering the

Mr. P. T. Davies

employment of the Montreal Light, Heat and Power Company. From 1909 to March, 1913, he was operating superintendent, and in 1911 he was also appointed chief power agent. In March of this year, Mr. Davies relinquished the first position, and while retaining that of chief power agent was also made assistant to Mr. R. M. Wilson, general superintendent and chief engineer. It will be seen that Mr. Davies has made very great progress in his profession since he came to Canada. He is exceedingly energetic, and it was due largely to his efforts that the Montreal Electrical Society made such rapid growth during the first year of its existence.

The Dealer and Contractor

Control of Stationary Suction Cleaners

The accompanying illustrations represent the correct method of wiring up for a stationary suction cleaner operated by alternating current motor. Fig. 1 shows a 3-phase motor operated from one point only, which is generally in the basement close to the motor. Fig. 2 represents a 2-phase, four wire system, operated through an automatic starter, also from one point only. For 2-phase, three wire arrangements, leave off the line marked B and use the line marked A as the common return.

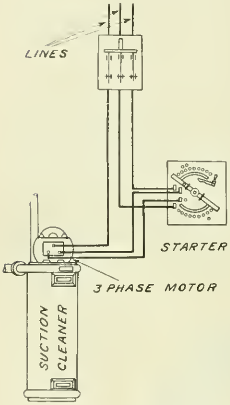


Fig. 1

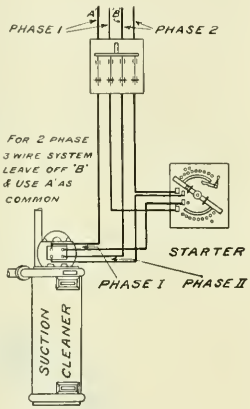


Fig. 2

The Hydro-Chronograph

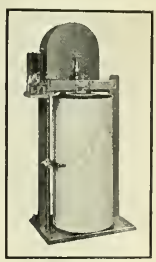
With the increasing developments in water and water-power plants and the consequent increasing need for water conservation there has arisen the necessity for accurate data on the flow of streams and rivers over varying periods and at various seasons of the year. The collection of this data has always been attended with more or less difficulty and inaccuracy on account of the lack of proper instruments, and we describe and illustrate herewith a new equipment for registering the fluctuation in water level in a river or reservoir which seems to be a decided step forward in the manufacture of this type of equipment. This apparatus is known as a Hydro-Chronograph and is manufactured by the Hydro Manufacturing Company, of Philadelphia. It is already in use in various parts of the United States and Canada, including Prince Rupert, B.C., Sault Ste. Marie and Niagara Falls, and is now being installed by the municipality of the town of Swift Current.

The Hydro-Chronograph proper is an instrument with a clock-driven drum which makes one revolution in twenty-four hours, seven days, or thirty-one days, as may be desired. The record is made with a recording pen which is operated by a float, the reducing mechanism being bevel gears and a four-thread screw. Primarily this device was intended to be located at the point registered, but the manufacturers have succeeded in applying an adaptation of electric telegraphy by which it is not only possible, but entirely practicable, to have the instrument itself in the office of a manufacturing plant or municipal pumping station and record the condition of river or reservoir several miles away; which, for instance, in the case of a pumping station, would keep the engineer constantly in touch with the conditions at the reservoir and thus enable him to regulate his pumping accordingly, cutting out probably 90 per cent, of waste pumping.

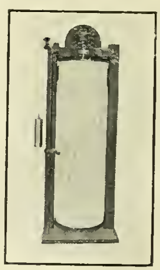
This long distance feature is worked out by a simple device, worked by the float, which operates a standard telegraph key whenever the water rises or falls a fraction of an inch. The contact thus made closes a standard telegraph relay in the immediate neighborhood of the instrument, throwing into circuit a relay or local battery which operates a solenoid on the instrument, ratcheting over a wheel one tooth in either direction whether the water is rising or falling. This is so simple and substantial that there is very little opportunity for casualty of any kind.

In hydro-electric work there is a special type of Hydro-Chronograph designed which makes two records on one card, the upper portion being the record of the head water and the lower portion the record of the tail race. This type, as well as all other forms of the Hydro-Chronograph, can be operated from a distance if desired.

Still another type is the Hydro-Chronograph Weir Gauge which is remarkable inasmuch as it will make a record through a maximum of two or three feet without any reduction or on a reduction two to one through a variation of four or six feet This, of course, means that an enormous card is used, this being two or three feet wide and in point of time being for 28 hours, 7 days or 28 days; but the record thus obtained shows the slightest variation in the water level of a weir. This type has been found extremely useful and valuable not only for weirs—for which it was designed—but also for work of sewage departments in cities where the flow is tabulated by means of these records.



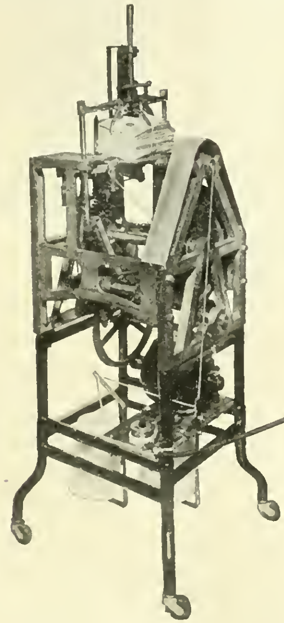
Long Distance Hydro-Chronograph



Hydro-Chronograph Weir Gauge

Automatic Package Tier

A few seconds saved in operation that must be constantly repeated mean many minutes by the end of the day, and the saving of minutes often means the saving of many dollars in the busy office. That is the reason why small motor driven machines are being used so extensively in modern business houses for operations such as sealing and stamping envelopes, opening letters, running adding machines, duplicators, addressographs, etc. One of the latest of these time and labor saving devices to make its appearance is the automatic package tier. It is designed primarily for tying mail matter into packages, but has many other applications besides. It takes bundles of from 25 to 50 letters, and in 2½ seconds binds them into a neat, compact package and



Another small motor application.

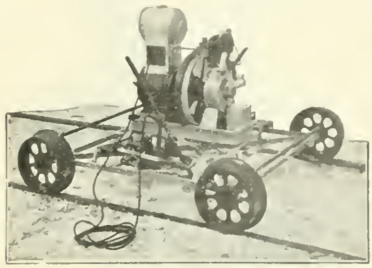
drops them into the mail bag or other receptacle. Where much mail matter is handled, it permits a reduction of the clerical force and enables earlier mails to be caught. The machine is made by the Automatic Package Tier Co., Chicago. It is operated by a 1/8 Westinghouse small motor which takes current from the lighting circuit.

Secondaries "Must" be Grounded

The "1913 National Electrical Code," of the National Fire Protection Association, will be issued in about two months' time. At the annual meeting of the association, held in New York at the end of March, the code was revised, alterations and additions being made to the code issued in 1911. The most important alteration is to Rule 15, where the word "may" is changed to "must," the rule now reading "Transformer secondaries of distributing systems must be grounded provided the maximum difference of potential between the grounded point and any other point in the circuit does not exceed 150 volts; and may be grounded when the maximum difference of potential between the grounded point and any other point in the circuit exceeds 150 volts." A new table of the carrying capacity of wires has been compiled, increasing the current to be carried; while new rules for garages have been added to the code. The Canadian Fire Underwriters' Association, Montreal, are having the code translated into French for the benefit of French-Canadian electrical contractors.

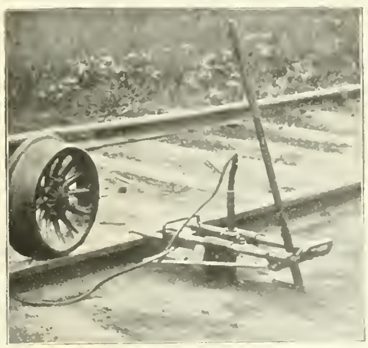
Electric Bonding Outfit

An apparatus specially designed for furnishing electric current for the operation of Duntley electric drills for the rapid drilling of holes for signal bonding of steel railroads is shown in the accompanying sketches. The generating equipment consists of a single cylinder four cycle gasoline engine, direct connected to a 1¼ kw. generator wound for 125 volts. The engine and dynamo are direct-connected and mounted on a welded steel frame made of 3-inch channel steel and when detached from the truck can be provided with two pipe handles so that the entire outfit can easily be car-



Gas-electric unit on truck.

ried by two men. The generating unit, however, is usually mounted on a four wheel truck with welded channel steel frame and supplied with pressed steel wheels, this truck having a wheel base of 50-in. The weight of the four-wheeled truck with generator, is approximately 500 lbs. The engine develops about 5 h.p. at a normal speed of 1500 r.p.m. The generator is compound wound to take care of excessive loading, and the shaft is supplied with ring oiling bearings. The switchboard has a provision for making connections to two electric bonding drills. A fuse block is enclosed in the switch case and lock, and covers are provided so that the entire switchboard may be locked up. This generating outfit is



Drill operating in adjustable frame.

capable of operating two bonding drills simultaneously. The drill itself is mounted on an adjustable frame as shown herewith, hooking over the rail to be drilled and can be applied or removed in a few seconds. It is possible to drill 30 to 40 rail joints, four holes per joint, per hour, with each drill. This equipment is manufactured by the Chicago Pneumatic Tool Company.

Reminder Clocks

An unique and interesting improvement in clocks has just been brought out by the Darche Manufacturing Company of Chicago, in their "Reminder" clock. This clock will be of value in offices, factories, hotels, garages, schools, stores, etc. The placing of a plug in a hole opposite to such time as one may wish to be reminded of an appointment, a telephone call to be made, or any other special duty to be performed, will cause a buzzer to sound at the time

Reminder Clock

plugged and, the buzzer will continue to sound until the plug is removed. The clock has an eight-day movement. The buzzer is operated by a dry battery, both being concealed in the clock. This reminder clock is mounted as shown, or in a wall case 22 x 30 in., with a blackboard or plain surface and furnished with a 6-inch alarm bell.

Magnetic Disc Brakes

Accessibility of parts is a very important feature in multiple disc brake construction. This feature is one of the advantages of a new type of magnetic disc brake manufactured by the Cutler-Hammer Manufacturing Company, and shown in the accompanying illustrations. With this type, to remove or replace a disc, it is not necessary to remove the brake from the shaft and practically dismantle it, but the mere loosening of three bolts which secure the magnet coil in place will give access to the interior and the discs can then be slid out along the shaft and easily replaced. The brake itself is left secured in place. This design also provides for ventilation; the rotating discs shown in the exposed view, Fig. 2, have cored radial passages similar to those in the runner of a centrifugal pump. When set in motion air is drawn in through inlet passages in the hub and ejected from outlets provided in the side of the disc—enclosing frame under the cover. The good ventilation secures better capacity and wearing qualities. No lubrication is required.

This new line of brakes is rated in h.p., maximum torque in pounds-feet, and capacity in feet-pounds per minute. For different kinds of service, such as for crane hoist, screw-down of a rolling mill, etc., the particular brakes suited to the requirements can be selected.

Structurally, these brakes consist of a hub; a series of stationary and rotating discs; an enclosing case; a spiral spring and an electric-magnet. The hub, which is mounted on the shaft, carries the rotating discs. These are interleaved between the stationary discs which are anchored to the enclosing case. The stationary discs are faced with a product having a high coefficient of friction and the rotating discs have internal radial air passages. Normally, the stationary and rotating discs are engaged by means of a spiral compression spring. The electric magnet serves to compress this spring and release the pressure on the discs when it is desired to remove the brake. The intensity of the brakeing force can easily be adjusted, the brake application and release being made without shock or hammer. The actuating forces are balanced within the brake so that there is no end thrust imposed on the shaft to which they are attached.

In Fig. 2, 102 represents the magnet case; 104, the armature plate; 105, the hub; 107, end stationary discs; 108, rotating discs; 109, intermediate stationary disc; 110, friction lining; 112, brake frame.

Electricity in the Manufacture of Jewelry

Many claims are justly made regarding increased production and economy in power consumption resulting from the use of electric drive. Not only is there an ecenomy in friction losses, but the ability to work a tool at its maximum capacity and the fact that power is being consumed only when work is being done are also most important considerations. The latter fact should receive great consideration from the manufacturing jeweler, as the length of time he uses his machinery must necessarily be short. One of the greatest advantages of electric drive is its flexibility, which quite readily affords small sub-divisions of power so that it becomes practicable to use motors either for individual tools or to drive groups for a sequence of operations.

Due to the varying conditions to be met in different factories, it is impossible to make any general recommendation that would be applicable to any special installation. An intimate knowledge of the manufacturing processes to be served is quite as necessary to the designer of an electric drive as to the manufacturer himself. These are matters that require special knowledge and experience. Many manufacturing houses make a specialty of studying the requirements of these situations and their advice should be sought before installations are made.

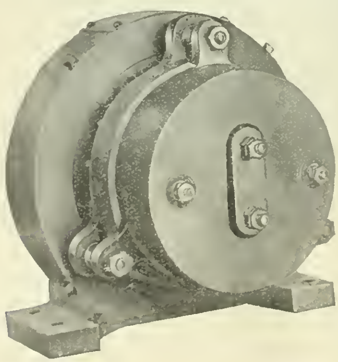


Fig 1—Rear view of magnetic disc brake

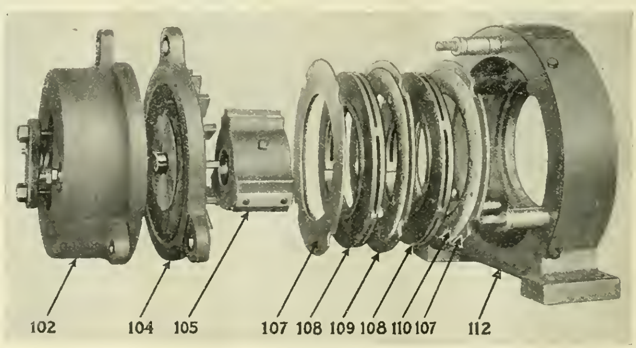
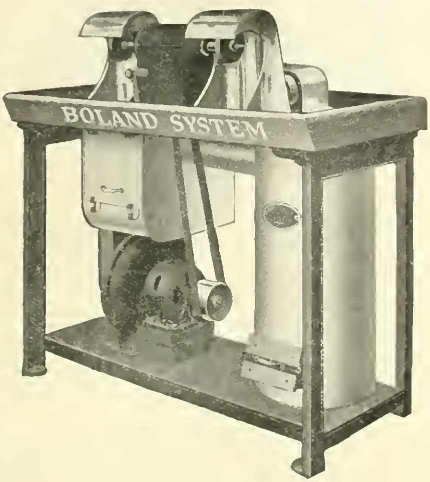


Fig. 2—Exploded view, magnetic disc brake

Among the many manufacturing concerns who have made special investigations into the application of small motors is the Holtzer-Cabot Electric Company, who have just issued a booklet dealing with the adaptability of motor drive to the requirements of the jewelry trade. The booklet contains also a number of illustrations showing motors operating polishing benches of various sizes, the polishers being driven either individually or in groups; buffing and grinding equipments of various kinds; scratch brushes; hot blast drying apparatus; positive pressure blowers; lap wheels; breaking down rolls; bench drills, etc. The booklet also describes and illustrates dynamos and their auxiliary equipment for electro-plating work.



Electricity in the Jewelry trade

Electric Arc Welding

The day appears to be passing when ordinary defects, such as shrinkage, cracks, blow holes, etc., in expensive castings necessitate the making of another casting; or when a crack in a street car truck or a brake of a locomotive train means the keeping of the car or locomotive out of service while a new part is being manufactured. Defects such as these can now be quickly and comparatively cheaply repaired by welding.

The C. & C. Electric & Manufacturing Company are placing on the market an electric arc welding equipment, which is claimed to differ from other forms of welding, in that by using an electric arc to produce a high temperature, the two pieces of metal to be joined are actually melted and flow together into one piece, instead of being merely softened by heat, and then caused to unite by the application of pressure or by hammering. It will thus be seen that the metal really becomes continuous and homogeneous. The electric arc permits the welding also of such metals as copper, brass, etc.

The heat given by the electric arc in this equipment is most intense, being about 4,000 deg. C., which is sufficiently high to reduce most ordinary metals to the liquid state and has the further advantage that, being applied quickly, the conductivity of the metal cannot carry the heat away fast enough to lower the temperature at the point of welding. This explains how the electric arc can be applied to as small an area as desired without dissipating heat over the whole work, which, in the case of a large casting means a very great loss. Further, the equipment is easy to manipulate, requires no complicated apparatus or previous preparation for the work in hand and it is claimed to be the cheapest method so far devised for obtaining such high temperatures on a commercial scale. There is also a large factor of safety associated with the use of this equipment; there is no danger from explosives and only low voltage currents are used; no hurtful gases are given off.

The apparatus necessary in one of these complete electric welding sets is (1) A driving motor direct-connected to (2) a welding generator, (3) a switchboard on which is mounted the necessary control apparatus, (4) electrode holders, (5) face and hand shields for operators.

An idea of the cost of making ordinary repairs can be gathered from the following data, showing how this welding outfit turned out work in one electric railway repair shop. The column giving costs is figured out at 2c per kw.h. for current and 30 cents per hour for labor, but it can readily be figured out what the different operations will cost in any shop by using the figures in column (1) and (2) and substituting proper costs for labor and power.

Showing operator with one type of head shield and combination electrode holder for both metallic and graphite electrodes

	Time.		kw.	Average Costs.
Gear case lugs	10	min.	6	$ .07
Armature shaft (broken) 2-in.	60	min.	20-30	.80
Dowell pin holes	5-12	min.	4-8	.07
Broken motor cases	2½-3½	hrs.	75-90	4.98
Broken lugs on a compressor cover, doors and grease-cup hinges	2-5	min.	1-3	.03
Broken truck frames	30-60	min.	20-35	.63
Worn bolt holes in motors and trucks	5-10	min.	3-5	.05
Enlarged and elongated holes in brake levers	2-4	min.	1½-3	.03
Armature shafts, 2-in. worn in journals	2-3	hrs.	65-90	3.75
Armature shafts, worn in keyways	10-15	min.	7-12	.10
Armature shaft, worn thread	20-30	min.	10-15	.24
Air brake armature shafts (broken)	20-30	min.	10-20	.27
Leaking axle boxes	5-15	min.	3-7	.08

Northern Boltless Guy Clamps

The Northern Electric & Manufacturing Company have purchased from W. N. Matthews & Company, St. Louis, Mo., the patent rights for Canada on the "Matthews Boltless Guy Clamps," and are manufacturing these in Canada under the name of Northern Boltless Guy Clamps. Primarily the boltless guy clamp was designed to eliminate the cumbersome, time-consuming process of attaching guy and span wires to poles and anchors. Since it has been in actual service numerous other advantages have been found which alone made its use worth while. The Northern boltless guy clamp is manufactured in two sizes, the "Giant" for guy strand 5/16 in. and 7/16 in. in size, and the "Baby" for use

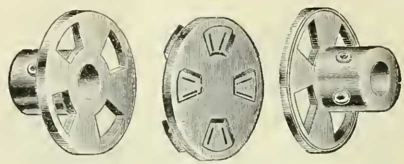
Boltless guy clamp.

on ¼ in. and 5/16 in. strand. In principle the clamp is simple. It consists of a wedge grooved on one side and smooth on the other, which fits into a tapered sleeve with internal grooves on one side. These grooves on the wedge and sleeve when mated form for the strands a pair of channels which are gradually reduced in section as the wedge enters the sleeve.

To apply the clamp, the span or guy strand is run through the sleeve, thence around the pole or through the eye of the anchor and back through the sleeve. The wedge is then inserted in the sleeve, and as it is driven tight it wedges the wire securely the two sections of strand filling the grooves. The double groove, in the sleeve and wedge permits clamping without deforming the strand, and as the tension in the strand comes as much from the section in direct line with the guy as from the one forming the stub end, the clamp can be set in either direction according to convenience in driving the wedge. The time required to apply the clamp after the slack has been taken up in the strand is almost negligible, most of it being consumed in detaching a short section of wire from the strand and giving this a few turns around the guy to make the connections neat in appearance. Another advantage which has developed through actual service is the ease with which sags may be taken up in new line while the poles are assuming a permanent set. This is accomplished by applying a "come-along" and small block and fall between the span wire and the pole and after the slack is taken up the wedge is removed, thus allowing the slack to pass through the sleeve. The wedge is then reinserted and driven tight.

Flexible Insulated Coupling

The Canadian Bond Hanger and Coupling Company, Limited, of Alexandria, Ontario, announce that they have secured the sole rights to manufacture and sell the Grundy Patent Flexible Insulated Coupling for Canada. The Grundy coupling has been sold in England and the United States very extensively, for the last two or three years. It is one of the newest devices on the market in the way of a flexible insulated shaft coupling, and is designed for the transmission of power from one shaft to another, where electrical insulation and a moderate degree of flexibility are desired. The two outside flanges can be either keyseated or setscrewed to the ends of the shaft. The central disc is made of special selected leather and has lugs securely cemented and riveted to each side; the disc supplies the insulation and the lugs transmit the power to the outside flanges. The Canadian Bond Hanger and Coupling Company, Limited, claim that this coupling will transmit more power than any

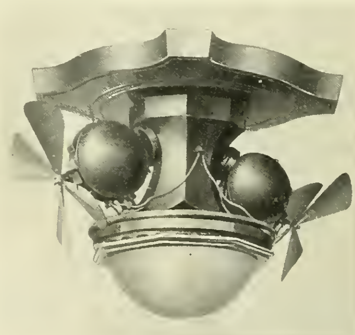


Grundy flexible insulated couplings.

other coupling of equal diameter, and that it will sustain uneven shocks. Where it is not possible to secure perfect alignment of shafts, the coupling will adjust itself to any such inequalities. These couplings are made in sizes from 3-in. in diameter to 30-in., so that they are applicable to small machinery, and also for the largest units. The Grundy can be run in either direction, at high or low speeds, and is claimed to be specially well adapted for connecting engines to generators, motors to pumps, sewing machines, machine tools, printing or wood-working machinery, etc.

Combination Fan & Lighting Unit

One of the most novel improvements in car lighting fixtures of recent date is a combination gyrofan lighting unit as shown in the accompanying illustration. This type of unit entirely relieves the congested appearance of the upper deck of the car. The gyrofan is placed directly over a lighting unit and revolves about the centre stem of the fixture as an axis. The type of bowl used in this installation is one specially designed for uniform distribution of light, but different effects, possibly more pleasing, may be



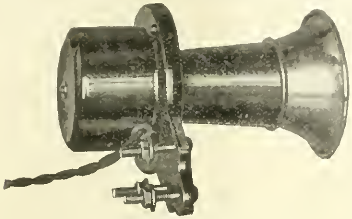
Gyrofan for railway service.

obtained, by varying the glassware. This unit has been designed by the Adams-Bagnall Company for use in a Lake Shore diner. The unit is about 16 inches in vertical measurement. One of the points of advantage claimed for the unit is the fact that the fans are placed above the lighting fixture so that there are no flickering shadows caused, either when the fans are in motion or at rest.

The Eugene F. Phillips, Electrical Works announce that owing to increase in business they have moved their Winnipeg office to more commodious quarters at suite 602 Electric Railway Chambers. Mr. W. H. Reynolds is western manager for this company, with headquarters at Winnipeg.

A Stop-Look-Listen Horn

The illustration herewith represents an electric automobile trumpet manufactured by the Adams-Bagnall Electric Company and being placed on the Canadian market by Mr. R. E. T. Pringle. The trumpet is operated by an electric

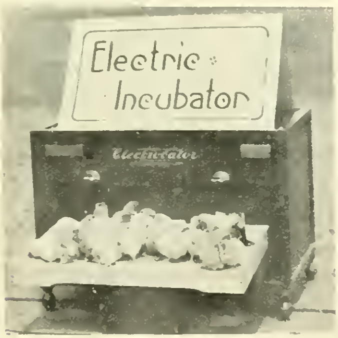


Stop-look-listen horn.

vibrater, which works on the same principle as an interrupter in an induction coil, or the vibrating armature in an electric bell. The construction features include (a) sterling silver contacts, (b) phosphor bronze main spring which will not rust or change its tension, (c) hard steel diaphram, (d) pin rivetted to diaphram, (e) no exposed binding posts or screws, (f) no loose wire leads from coils, (g) a novel method of adjustment. On account of its effectiveness this trumpet is known as the Stop-Look-Listen horn.

Electric Incubators

Considerable interest was aroused in poultry fanciers' circles at Vancouver recently by the spectacle of a brood of downy chicks which were hatched out in an electric incubator, placed in the show room of the B. C. Electric Rail-



Chicks, 24 hours old.

way Company at the corner of Carral and Hastings streets. The eggs reposed in the incubator for a period of three weeks, and true to nature the chicks appeared on the day assigned for the hatching to take place. The heat is provided by electric current, a thermostat regulating the temperature so that but little attention is required in operating the incubator.

Wood oil is produced from the nuts of the "tungshu" tree of China, and practically the entire supply comes from that country. Its normal price is 2s 6d.—60 cents—per gallon, and in the fiscal year ending June 30th, 1911, the United States imported 5,000,000 gallons. The wood oil tree will grow along the Pacific Coast, south of Sacramento, and in the Gulf States. Another source of supply is the Kukui nut or candlenut, which grows in Hawaii and the Philippines. If the nuts can be gathered and the oil extracted profitably this oil should compete with Chinese wood oil.

New P & S Devices

The Pass & Seymour Company have just made a number of important additions to their line of handy wiring devices, as illustrated in the accompanying figures. Figures 1, 2 and 3 are key, keyless and pull type receptacles respectively, for use with condulet base; figures 4, 5 and 6 are key, keyless and pull type receptacles respectively for use with wood moulding or Paiste type taplets; figures 7, 8 and 9 are key, keyless and pull type receptacles respectively for use in open wiring. All of these nine receptacles embody the Fluto style interchangeable shell. This Fluto shell, as used on these receptacles, is interchangeable with the entire P. & S line of Fluto sockets and receptacles.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

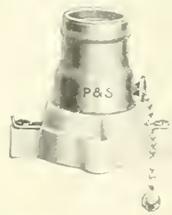


Fig. 9.

Fig. 10 represents a pull receptacle exclusively for use on 4 in. boxes; in the past it has been the practice to use, on outlet boxes, a pull receptacle which was primarily designed for use as a wall receptacle. The porcelain projecting ring of this new type insulates the metallic shell from the box and from the ceiling, thereby permitting its use on metal ceilings. This receptacle is regularly supplied with pull chain 18 inches long, but may be supplied on special order with chain of any length or, if desired, with a silk cord in place of chain.

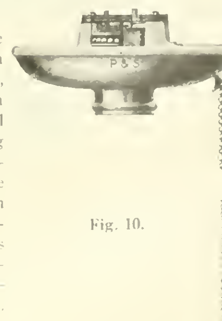


Fig. 10.

The Innisfil Telephone Company, Limited, has been incorporated with a capital of $12,000, to carry on the general business of a telephone company with head office at Lefroy. The provisional directors are Ebenezer Todd, W. J. Ralston, and G. C. Allan, all of the township of Innisfil, County of Simcoe, Ont.

Electric Irons

What are the desirable qualities of an electric iron? To this question an expert housewife replies.

1. That it shall be perfectly free from any liability to shock or burn the operator.

2. That it shall be suitable for ironing all classes of material quickly and well.

3. That it shall have a long life, and be of such construction that it can be easily repaired, if necessary.

To meet such demands a small army of heating device experts in the various factories of the leading electrical manufacturers have spent much time in research and experiment. A host of types and styles have been developed, and

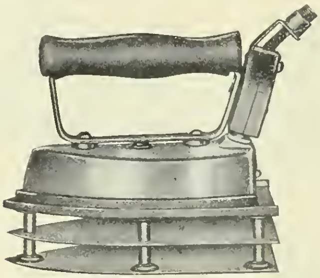


Fig. 1.—Iron with special stand.

quickly superseded by superior designs. This process of survival of the fittest has gone on for some years, special effort being concentrated on the household iron, which now possesses the qualities called for by the most exacting operator. Among the very latest products, is one offered by the Canadian General Electric Company, and known as their Type F-13. F-13A (Fig. 1) shows this iron on a special ironing stand; F-13B (Fig. 2) is equipped with a permanent heel stand. Attention is drawn to the following points in construction and finish.

1. A one layer calorite leaf heating unit, thoroughly insulated with sheet mica, and in intimate and even thermal contact with the working body of the iron. Calorite melts

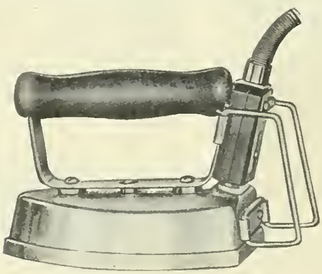


Fig. 2.—Iron with heel stand.

at 2370 deg. Fah.; that is, ten or twelve times its working temperature.

2. A shell cover, providing a dead air space over the top and around the sides of the iron, effectively cutting off heat radiation from the operator's hand.

3. A heel stand can be permanently attached, on which the iron is rested when not in use. No separate stand being required.

4. Heavily insulated and protected cord attached to a contact plug, constructed so that loose connections are impossible.

5. A barffed finish has been found most satisfactory for the actual ironing surface. All other parts heavily nickel plated, give the iron a very attractive appearance.

Holophane Equipment

The Holophane Company, Limited, Toronto, have recently added several beautiful new semi-indirect bowls to their established lines of Calla and Veluria. Other designs are now in the works and will be brought out in ample time for the coming season. Like all the other products of this company, these semi-indirect units are scientifically constructed to produce maximum results in illumination. At the same time it has not been necessary to sacrifice the artistic effect, and these new units are not only graceful and pleasing in their general design but in the Veluria and Calla they embody a most beautiful finish, showing the rich effects of a carved alabaster and delicate tracings like a beautiful brocade. Invisible bands can also be furnished for these with swivel ball-socket joints and for such units as are drilled for hooks, special hooks are provided. This feature makes these units particularly desirable for fixture houses, permitting them to elaborate on fixtures. Bracket globes are also furnished to match these various units so as to complete the installation.

Semi-indirect units are reported to be meeting with an

1209 VEL.63.

unusual demand at the present time, and where they are scientifically designed provide not only an ample illumination but a high quality of lighting, eliminating objectionable glare to a very great extent and providing a system specially adapted to the relief of the eyes.

The Holophane Company are distributing an illustrated bulletin, showing their new line. They place their engineering department at the disposal of any prospective customer and gladly offer any assistance, or information, as to the proper installation of any of their equipment.

New Bell Factories

The Bell Electric Motor Company are constructing two modern fireproof steel and concrete factories about 200 feet long, to be used as an addition to their present factory. Special attention has been given to proper lighting and the installation of modern testing apparatus, by means of which single, two and three phase current is available for all commercial voltages.

Mr. W. H. Patton has been appointed supervisor of signals on G. T. R. Ontario lines, with headquarters in Toronto.

Current News and Notes

Aurora, Ont.

A by-law was submitted to the electors of the town of Aurora on June 30, approving an agreement made by the council with the Toronto & York Radial Railway Company for the supply of electric light and power.

Abbotsford, B.C.

Convinced of the splendid field which the town and district of Abbotsford, Fraser Valley, offers for the sale of electrical appliances, the B. C. Electric Railway Company intends to erect a show room and office for its light and power department at this point. Tenders for the construction of the building have been called for. The building will be a frame structure located just to the south of the company's tramway station. It will be 23 x 25 feet in size and one storey in height. The front portion of the building will be used for a show room for electric appliances, large plate glass windows being placed along its frontage which will be on a level with the station plaform. In the rear of the building are located two rooms, one of which will be used as a store room, and the other as an office for the company's light and power representative.

Amherst, N.S.

The Maritime Coal & Railway Company are said to have their plans in progress for a $5,000 transformer station.

Brockville, Ont.

Mr. J. W. Butler, of Poole's Resort, is installing a Fairbanks-Morse lighting installation with a capacity of 165 40-watt lamps. The installation also includes a storage battery equipment of sufficient capacity to carry thirty-six lamps for sixteen hours. A 4 h.p. kerosene engine will also be installed for power purposes. Mr. A. Stuart Allaster is architect for the work, which is being installed by Geo. Ross & Company, contractors, Brockville.

Brandon, Man.

A by-law recently passed authorizing the expenditure of $150,000 for additional railway extensions.

Calgary, Alta.

A by-law was recently passed authorizing additions to the power house equipment including gas-fired boilers and turbo-generators of 6600 h.p. capacity.

Cornwall, Ont.

The Canadian Cottons Company have recently installed a 650 kv.a., 2300 volt, three-phase, 60 cycle generator in their Cornwall factory. the generator is rope driven and can be operated by water or steam power; the electrical equipment is of the Swedish General Electric Company's make, supplied by Messrs. Kilmer, Pullen & Burnham, Toronto.

Dundas, Ont.

It has been proposed by the Water & Light Committee to illuminate all the approaches to the town. It has also been suggested that the town council co-operate with the surrounding municipality councils with a view to lighting the rural highways for some distance out.

Grenfell, Sask.

A by-law will be submitted on July 4, authorizing the expenditure of $15,000 on an electric lighting plant. It is probable the system will be installed by the British Canadian Engineering & Supply Company, of Winnipeg, which will consist of a producer gas equipment operating a small generator.

Galt, Ont.

The municipality of the town of Galt have installed a motor-driven stone crusher. The crusher is set on a permanent base and operated by a 30 h.p. motor.

Gananoque, Ont.

On July 7 a by-law will be submitted, authorizing the town to grant a bonus of $20,000 to the Gananoque and Arnprior Railway Company.

On July 7 a by-law will be submitted authorizing a contract between the Gananoque Electric Light & Water Supply Company and the town of Gananoque. The company agree to operate six arc lights and 250 60-watt tungsten lamps for street illumination, the former at $60 each and the latter at $720 each per annum. Commercial lighting is to be charged at the rate of 10c per kw.h. with 35 per cent. discount; or at 8c per kw.h. for the first 30 hours use of the installed capacity and 4c per kw.h. for all over this amount, with 10 per cent. discount. Residence lighting is to be 10c per kw.h. with 35 per cent. discount, or 4c per hundred square feet monthly plus 3c per kw.h. for all current consumed, with 10 per cent. discount.

Merritt, B.C.

Within the next year the municipality of the City of Merritt will install a second 125 kw. unit, 3-phase, 60 cycles, 2300 volts.

Montreal, Que.

Mr. William W. Ashland, superintendt of telegraphs for the Grand Trunk Railway, died suddenly, at his residence in Montreal, on June 19th. Mr. Ashland, who died from heart failure, following pneumonia, was connected for many years with the Grand Trunk telegraph department, joining the staff in 1899. He was born in Ohio, and was identified with railway work in Chicago and Detroit before coming to Canada.

New Toronto, Ont.

The council of the village of New Toronto will shortly submit a by-law authorizing the expenditure of $47,000 on electrical distribution equipment.

New Westminster, B.C.

The staff of the city electrician recently completed the work of doubling the voltage on the Sapperton and Queensborough circuits at New Westminster, both these circuits now carrying 2,000 volts.

Ottawa, Ont.

Bonus by-laws in connection with the St. Lawrence & Ottawa Electric Railway system have been carried in Winchester village and Osgoode township but defeated in Winchester township.

The Connaught Park race track near Aylmer, Que., which held its inaugural meet from June 14th to June 21st inclusive, drew big business for the Hull Electric Railway.

The company built a spur line from the main line to the park, a distance of about half a mile, and charged a fare of ten cents straight for a one-way trip to the park. About 50,000 travelled on the cars during the seven days the racing was held. Cars left the Chateau Laurier station every three minutes. The park is about five miles from Ottawa.

The Ottawa Collegiate Institute Board have decided to open classes for industrial training in the city on October 1st, this year. The programme of subjects to be taught include electricity, both practical and theoretical, practical English, workshop mathematics, freehand and geometrical drawing, building construction, architectural drawing, chemistry, physics and applied mechanics.

Peterborough, Ont.

The Hydro-electric Power Commission of Ontario have been asked to set a price on the distribution system of the Peterborough Light & Power Company so that the local power committee may be in a position to know what price they should offer for this equipment.

Port Arthur, Ont.

The municipality of the city of Port Arthur have awarded a contract for the complete electrical equipment for their new pumping station to the Siemens Company of Canada, Limited. The equipment will consist of three 275 h.p. self-starting, 3-phase, 60 cycle synchronous motors; an 8-panel switchboard; motor-generator exciters; transformers, cables, etc. The pumping equipment will be supplied by Messrs. Escher Wyss & Company.

The Siemens Company have also received repeat orders from the Hydro-electric Power Commission of Ontario for two further 22,000 volt feeder equipments, each of 2500 kv.a. capacity, for the Port Arthur sub-station. This company have carried out the complete electrical equipment for this station, which consists of seven 750 kv.a., 22,000 volt transformers; a 20-panel switchboard; lightning arresters; and two 750 h.p. motor-generators.

Russel, Man.

The village of Russel, Man., has recently installed a Rustom-Proctor, 75 h.p. suction gas engine, a Rustom-Proctor gas producer and a Westinghouse 2200 volt, 3-phase generator, with exciter and necessary switchboards, rheostats and transformers, etc. This equipment was all supplied by the British Canadian Engineering & Supply Company, Winnipeg. The building which will house this equipment will be of one storey, brick, 19 feet x 93 feet, including offices, etc. The village will install about 30 80-watt tungsten lamps for street lighting and about 80 5-amp. single phase meters to control about 1,000 lights. From present appearances it is expected that this plant will have to be doubled before the season is over.

Regina, Sask.

Tenders are called by the city commissioners up to July 12 for two vertical-shaft motor-driven centrifugal pumps.

A by-law was recently carried authorizing the operation of the street railway system on Sundays.

Renfrew, Ont.

The Renfrew Electric Manufacturing Company, Limited, has been incorporated with head office Renfrew, Ont.

Smiths Falls, Ont.

The Smiths Falls Electric Power Company have placed an order with the Canadian Westinghouse Company for a 275 kw. 3-phase, 60 cycle generator. This company will now change their entire system over from single to 3-phase.

Stellarton, N.S.

The Pictou County Electric Railway Company, Limited, are going to extend their line about three-quarters of a mile to the south end of New Glasgow, and will relay with heavier rails, the tracks on the main street. Mr. L. T. Flaherty is manager.

Sault Ste. Marie, Ont.

The franchise of the Tagona Water & Light Company expires in November, 1914, and it is said a movement is under way on the part of the town council to acquire this property and operate it as a municipal plant.

Stratford, Ont.

The franchise of the Stratford Railway Company has expired, and it is understood that the railway will not be built by the company unless a clause which requires them to buy power from the Hydro-electric Power Commission, is removed.

St. Thomas, Ont.

The city council recently decided to submit a by-law to the ratepayers in the near future authorizing an expenditure of $35,000 on double tracking Talbot street, from Stanley street to Alma street.

Toronto, Ont.

During the recent convention and general assembly in connection with the Presbyterian denomination held in Toronto, the generosity of the Toronto Railway Company in carrying all delegates free during the whole time of the convention was greatly appreciated by the delegates. A special communication was sent to general manager R. J. Fleming, stating that they had never experienced such uniform courtesy and consideration as that shown them by the street car conductors of Toronto.

Vancouver, B.C.

The North Coast Electric Company, Limited, has been incorporated with head office at Vancouver.

Thirty-five members of the Vancouver branch of the Canadian Society of Civil Engineers recently journeyed to Vancouver Island for the purpose of inspecting the steam auxiliary power plant of the Vancouver Island Power Company, situated at Brentwood Bay, a distance of 13 miles from Victoria. The visitors were shown over the plant by Mr. A. T. Goward, the Victoria manager of the B. C. Electric Railway Company, Mr. G. M. Tripp, local mechanical superintendent, and Mr. G. R. G. Conway, chief engineer of the company's system.

Welland, Ont.

A contract has been closed between the Ontario Hydro-electric Power Commission and the Union Carbide Company of Welland, under which the Commission agrees to supply the company up to a maximum of 16,000 h.p. The plant of the carbide company will cost in the neighborhood of $750,000, and, it is expected, will be in operation some time during the present year.

Yorkton, Sask.

On June 20, a by-law was passed authorizing the expenditure of $140,000 for the purpose of extending the present generating plant and for further distribution equipment.

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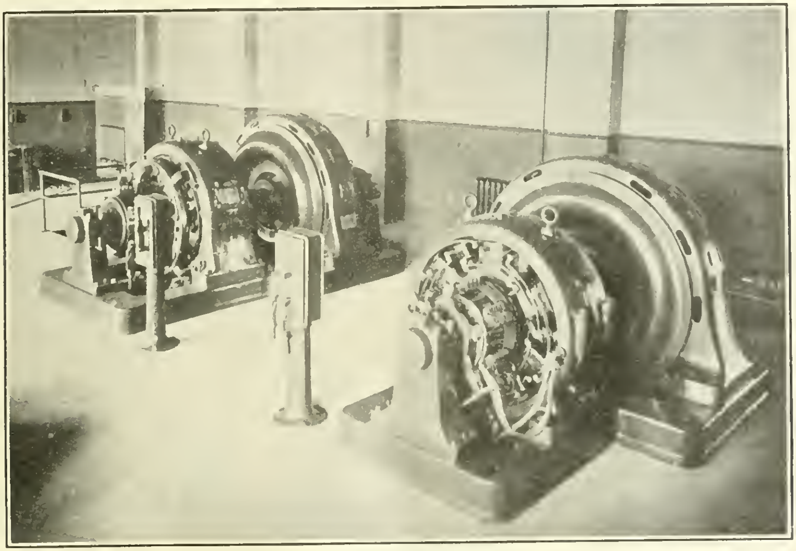

One 400 K.W. and one 200 K.W. Siemens Self Starting Synchronous Motor Generators, supplied and installed for the City of Lethbridge

We have delivered or on order in Canada amongst others the following motor generators:—

1-800 K.W. Dominion Coal Co., N.S.
1-800 K.W. Canadian Collieries, B.C.
1-700 K.W. Canadian Collieries, B.C.
2-500 K.W. Winnipeg
2-500 K.W. Port Arthur
1-400 K.W. Lethbridge
1-250 K.W, Canada Sugar Refinery Co.
1-220 K.W. Dominion Coal Co., N.S.
1-200 K.W. Lethbridge
1-100 K.W. Northern Ontario Light & Power Co.
2- 70 K.W. Winnipeg Technical Schools
1- 70 K.W. Canada Motor Co., Winnipeg
1- 50 K.W. Medicine Hat

Siemens Company of Canada, Limited

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Transportation Building - MONTREAL

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STANDARD BANK BUILDING
TORONTO

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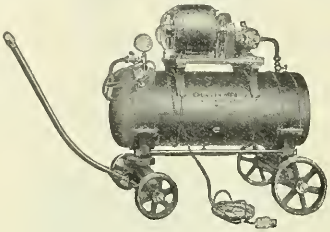
Portable Motor-Driven Automobile Tire Pump

The portable motor driven tire pump has been received with great favor by automobile owners and garages. It is brought to the car needing service so that its use eliminates the expensive, complicated and leaking air lines necessary with stationary installations. In private garages it furnishes complete relief from the back straining labor of hand pump-



Portable tire pumping equipment.

ing and enables the automobile owner to keep his tires at the pressure specified by tire manufacturers. In the outfit illustrated, the small motor driven air compressor is mounted upon the storage tank, the entire outfit being mounted on wheels. The compressor is driven by a one-half horse-power Westinghouse small motor which is operated from an electric light socket. The whole outfit is self-contained ready for operation the moment it is uncrated. It is provided with a pressure gauge, twelve feet of high pressure air hose, and an automatic tire connection, which shuts off the air when removed from the valve of the tire. The whole oufit has been made with great care and it is thoroughly air-tight. The pump is made by the Brunner Manufacturing Company, Utica, N.Y.

Transformer Station Will Be Enlarged

Owing to the addition to the No. 1 grain elevator of the Montreal Harbour Commissioners, the transformer station will have to be enlarged and re-arranged. The capacity of the elevator will be increased from one to two milfion bushels, and the addition to the station will be on a corresponding scale; when completed, the entire station will carry about 5,000 horse power, the current being supplied by the Montreal Light, Heat and Power Company. Most of the new electrical equipment has been contracted for. The Canadian Crocker-Wheeler Company will supply nine motors—4 of 150 h.p.; 4 of 40 h.p.; and one of 30 h.p.—a total of 790. These will be located on the various floors, and will be used in the conveying of grain to and from the bins, by means of belts. A contract for three 250 kw. transformers has been awarded to the Allis-Chalmers Company, while four 10 kw. lighting transformers will be supplied by the Canadian General Electric Company. The layout of the addition and the high tension work will be done by the staff of the Harbour Commissioners, under the supervision of Mr. T. E. Slater, the electrical engineer.

Mr. Arthur S. Herbert, formerly general manager of the Siemens Company of Canada, Limited, has resigned his position in Canada to accept the position of general manager of the branch offices of the Siemens Company in Australia. Mr. Herbert, who is now in England, will return to Canada early in July and will sail for Australia to assume his new position about the end of August. Mr. C. A. Ablett, who has been closely connected with the electrification of rolling mills in Europe during the past few years, and who recently made a brief investigation of the large steel works in Canada with regard to electric drive, will succeed Mr. Herbert.

Electrical News

Generation, Transmission and Application of Electricity

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Vol. 22 Toronto, July 15, 1913 No. 14

Railway Extensions as Local Improvements

While the East is cautiously discussing the advisability of adapting the "Local Improvement" plan to its street railway extensions, being unwilling to venture into a somewhat unknown field, the West has shown itself, as usual, more ready to grapple at first hand with the difficulty and in one case at least, in Edmonton, they have succeeded in obtaining the necessary power from the local legislature. At the last session of the Legislative Assembly of the Province of Alberta, the Edmonton charter was so amended that "Local Improvements" now include "the construction or extension of any tramway or street railway along any highway," the same to be paid for by a frontage assessment on the land facing the street along which the line runs, and also on land in the vicinity likely to be affected by this improvement. Not only is it possible by the new act to carry out these extensions on the "local improvement" plan, but it is specifically stated in the charter that no part of the cost of any "local improvement" shall be borne by the city at large unless the council, by a special by-law shall so provide. All "local improvements" may be initiated in either of two ways, (1) by petitions signed by at least two-thirds in number of the persons registered or assessed as owners of land abutting on the street, or of lands to be benefitted by the "local improvement," representing at least one half in value of such land or, (2) by report of the commissioners adopted by resolution of the council.

Edmonton's success will be watched with interest by many cities and towns in Canada, but in as much as transportation facilities have been the basis of most of our past developments it is difficult to foresee, at least in theory, that there is anything wrong with Edmonton's idea of development. That this is an authority that might be abused by the city council is another matter. However, even if the principle is overworked, the possibilities in favor of its success are still many, and with development as we have seen it in the last ten years Canada has little to fear from transportation extensions in any direction or by any means.

A Sane Fourth of July

For the first time since New York City began celebrating a safe and sane Fourth of July no money was spent this year for fireworks. Instead of dangerous pyrotechnical displays the Mayor's committee decided to omit them entirely in favor of electrical illuminations in the various public parks and on public buildings and monuments.

There were fifteen places in Manhattan and the Bronx where electrical illuminations were arranged. Eleven of the points are in Manhattan and four in the Bronx. Seventeen thousand electric bulbs of eight candle power each were used, making a total of 136,000 candle power of illumination. Three nights were scheduled for the lights to be turned on, July 4th, 5th and 6th, from 7.30 p.m. until midnight. All of the current required for the illuminations on these three nights was given to the city by the New York Edison Company, the only cost to the city being the stringing of the lights which was done by a number of private electrical contractors. The illumination on the City Hall and on the Bronx Boro Hall was donated by the Edison Company, including the lights and wiring, without any cost to the city whatever.

The illuminations in Manhattan were: City Hall, 3,000 lights, outline of building; Washington Arch, 2,000 lights, arch outline; Seward Park, 1,000 lights, structure in park outlined in lights; Tomkins Park, 1,000 lights strung through the trees; Columbus Park, 1,000 lights in the trees; Chelsea Park, 2,000 lights, poles erected and lights festooned from pole to pole; Central Park, 3,000 lights; Sailors' and Soldiers' monument, 1,000 lights; Thomas Jefferson Park, 1,000 lights; Grant's Tomb, 800 lights.

The illuminations in the Bronx were: Bronx Hall, 2,000 lights; McKinley Square, 700 lights; St. James Park, 500 lights; St. Marys Park, 1,000 lights, hung in streamers from a large pole in the centre of the park.

1500 Volts d.c. in Melbourne

As already announced, the Victoria Government, Australia, decided in December, 1912, to electrify the extensive system of suburban railways of Melbourne. The direct current system has been adopted in accordance with the advice of their consulting engineer, Mr. Merz, of London, who after thoroughly investigating the tenders submitted for alternating and direct current installations, came to the conclusion that in this case a direct current installation would be the most suitable. A 1500 volt direct current system (multiple unit system) with overhead supply has therefore been chosen. The total length of single track, including sidings to be electrified, is about 323 miles.

The order for the machinery for the twelve sub stations was placed with one of the Siemens Companies, of London, and comprises amongst other apparatus the following machines:—14 rotary converters, 2,000 kw. each; [illegible] rotary converters, 1,000 kw. each; 4 rotary converters, 500 kw. each; together with the necessary transformers. The transformers are supplied with 3-phase current at 19,000 volts. The reactance necessary for obtaining the proper regulation of the rotary converters is built in with the transformers. Six-phase current supplied to the three phase side of the rotary converters, and on the direct current side at 1,500 volts, is supplied from a single commutator

International Electrical Congress

Preliminary plans for the International Electrical Congress to be held in San Francisco during the week beginning September 13th, 1915, in conjunction with the Panama-Pacific International Exposition, and under the auspices of the American Institute of Electrical Engineers, are being effected by the Committee on Organization. In the week preceding the Congress there will be a meeting of the International Electrotechnical Commission. The Congress is being divided into twelve sections as follows:—

1. Generation, Transmission and Distribution.
2. Apparatus Design.
3. Electric Traction and Transportation.
4. Electric Power for Industrial and Domestic Use.
5. Lighting and Illumination.
6. Protective Devices; Transients.
7. Electrochemistry and Electrometallurgy.
8. Telegraphy and Telephony.
9. Electrical Instruments and Electrical Measurements.
10. Economics of Central Stations and Systems.
11. Electro-Physics.
12. Miscellaneous.

In each section it is desired to include as many as practicable notable papers dealing with the status or the progress of the art. Offers of papers and suggestions in this connection should be directed to the secretary of the Committee on Organization, Dr. E. B. Rosa, Bureau of Standards, Washington, D.C.

Fountain Falls Development

Fountain Falls is situated on the Montreal River between Ragged Chute and the point where the river enters Lake Temiscaming. It will be remembered that the installations on this river consist of a hydro-electric plant at Hound Chute, an hydraulic air compression installation at Ragged Chute and another hydro-electric installation near the mouth of the Montreal river, but situated on one of its tributaries, the Matabitchouan river. This fourth plant, when completed, will consist of four units, two of which are now in course of construction. The electrical equipment is of the Swedish General Electric type, vertical shaft, 3-phase, 60-cycle, 150 r.p.m., 12,000 volts, being supplied through the firm of Kilmer, Pullen & Burnham, Toronto. The turbines, of 2,000 h.p. capacity, are being manufactured by the I. P. Morris Company of Philadelphia. The engineering work is in charge of Messrs. Viele, Blackwell & Bucks of New York. The installation is being made for the Northern Ontario Light, Heat & Power Company who now control all the other water powers in the Cobalt district.

Electrical Equipment of Dry Dock

Tenders were recently called for the construction of a dry dock at Lauzon, two miles east of the town of Levis, P.Q. The electrical equipment of this government work will be of considerable proportions as may be gathered from the following data:—

The generators will consist of three direct-current units, 550 volts, one of 1,500 kw., one of 750 kw., and one 300 kw. capacity. These will be driven by steam turbine or by triple expansion reciprocating engines. The generators will be built so as to allow connection in multiple if required. A d.c. lighting unit 100 kw. capacity, 220 volts to be driven by a vertical direct-connected compound engine mounted on the same plate will also be required.

The switchboards will consist of 2-in. polished marble of standard construction and will be provided with all necessary volt meters, ammeters, wattmeters, overload circuit breakers, and all necessary switches. A distribution board will also be required, fitted with the necessary switches for the different circuits for power and lighting distribution.

Motors will be required as follows: three of 1000 h.p. capacity each for the main pumps; two of 125 h.p. capacity for auxiliary drain pumps; one of 125 h.p. capacity to be geared to worm operating the rolling caisson; one 15 h.p. unit on rolling caisson; four 15 h.p. units to operate the main culvert valves; two 100 h.p. units each on the floating caisson to operate the pump; one 10 h.p. unit to operate the sluice valves in the floating caisson. Motors will probably be required also to operate two capstans to be placed on each side of the dock. All motors are to be provided with starting and speed regulating devices.

All wires and cables leading to the lamps around the dock and to the different motors shall be laid underground in lead pipes and properly insulated. The underground cables will be led in glazed tile conduits bedded in concrete. No wire shall be smaller than No. 12 B. & S.

The power station will be 100 ft. x 120 ft. divided into 2 rooms, each 50 ft. x 120 ft., by a 12-in. wall. The floor of the generator room will be of concrete 6-in. thick on a 9-in. foundation of broken stone. The concrete will be overlaid with red tile approximately 6-in. square. The interior walls will be lined with a wainscoting of white glazed tiles rising 6 ft. from the floor, the upper part being finished with pressed brick. The chimney for the power house will be 180 feet high.

The illumination will be by both arc and incandescent lamps. It is probable a 15-ton travelling electric crane will be required in the generating room.

Saskatoon's Rapid Power Extensions

A civic power plant that has more than doubled, and in fact almost trebled, its capacity, within a year is somewhat unusual, to say the least, and that is one of the reasons why the power plant of the city of Saskatoon has proved of unusual interest to electrical men in the western provinces since the beginning of the year.

At the first of the year 1913 Mr. A. G. Sangster, who had been in charge of the power and electric light system in Saskatoon for the preceding two years, resigned to go into the private contracting business, and Mr. Edward Hanson, of the Canadian Light & Power Company, was appointed by the city council as electrical engineer for the city and soon afterwards Mr. J. R. Cowley, also formerly of the same company, was secured to take the position of superintendent of the power house. At this time the city were installing the last of the Babcock & Wilcox water tube boilers. They have now a total of eight, each of 500 h.p. capacity, fed with chain grate stokers working under an induced draft and having one set of economizers for each battery of two. The present boiler capacity of the plant is therefore 4,000 h.p. At that time also the power house had one 850 kw. and one 500 kw. Robb-Armstrong reciprocating engine. Soon afterwards the installation of a 2,000 kw. Allis-Chalmers turbine was completed and the 500 kw. machine was moved to the pumping plant to be used as an auxiliary. Since that time tenders have been called, and will be in shortly, for a 3,000 kw. turbine to take the place of the 500 kw. machine moved away.

Numerous additions have also been made to the power house since that time. A rectifier house has been built as an addition and all the power plant rectifiers have been installed in this addition. Work is in progress at the present time to take out the entire front wall of the engine room and leave it in the form of a triangle which will give 23 feet additional space at the extreme end. On this added space it is proposed to build an entirely new switchboard of the remote control type with duplicate bus-bars and switch gear generally. This new switchboard will be put down to handle 14,000 kw. on the idea of gradually eliminating the recipro-

eating units and replacing them with turbine units. It is hoped in this way to avoid having to extend the engine room for some time to come.

The highest peak load for the past winter was 2,320 kw., but when the turbine is installed this fall it is hoped to have a demand of 3,500 kw. It is the intention of the electrical department to ultimately have all cable feeders leaving the power house laid under ground and with this idea in view all the ducts have been laid and when the extensions are made in the near future the whole system will be put underground for some distance. The electrical department are also installing a track scale for the purpose of weighing all coal coming into the power house. The basis of payment will be fixed by these weights.

Montreal Tramway Improvements

As the result of a conference between a special committee of the Montreal Council, the Controllers, and Mr. E. A. Robert, president of the Tramways Company, a provisional agreement has been come to concerning measures to be taken to improve the service, and to avoid congestion at the rush hours. The basis of the agreement is the report submitted by Mr. G. Janin, the city's chief engineer, which has been ratified by the Council. The most important recommendation is for fifteen new routings and modifications of routings, while among the minor recommendations are the elimination of stops, increasing the switchmen, the improvement of signs on the cars, the cessation of smoking on the rear end of the cars, and the control of traffic at central points. Mr. Robert is of opinion that the report by Mr. Janin does not go far enough, and that it will make for only temporary relief. He suggests that later a more general plan should be worked out to meet conditions due to the growth of the population.

Some 1,200 men are being employed by the Montreal Tramways Company in relaying tracks in different parts of the city, part of an extensive programme which will be carried out during the next few months. The old rails of 96 lb. are being replaced with rails of 116 lb., the guard rails being increased to 132 lb. These will be the standards for the future. In all sections special cedar ties are being laid down, the length being increased from seven to eight feet, while they are put two feet apart instead of six feet. The roadbed has been greatly strengthened, with a view to resisting the frost. Eight inches of crushed stone are followed by two inches of stone dust as a bed for the ties, then comes six inches of concrete, the blocks being laid on this mass and grouted with cement, making a bed of 21 inches in depth.

After a long legal fight, the Montreal Tramways Company have obtained judgment, by the Court of Review, dismissing a conciliation board appointed by the Minister of Labour to consider a dispute between the company and certain ex-employees. Several conductors and motormen who were dispensed with secured the co-operation of an American street railway trades union, with the result that a conciliation board was appointed. Legal proceedings followed, and Mr. Justice Greenshields, in the Court of Review, has now held that none of the employees were members of the trades union which secured the appointment of the board of conciliation. He had no hesitation in deciding that the resolution on which the application for a Conciliation Board had been based had not been properly and legally passed by such a body as could be recognized by law. It had been contended that, when the Minister had appointed a board, his decision was final.

Kamloops—The Meeting of Waters

Kamloops is often spoken of as the Inland Capital of British Columbia, being delightfully situated at the junction of the North and South Thompson Rivers, from whence it receives the name Kamloops—an Indian word meaning "the meeting of waters." Kamloops might also be called the meeting of railways, for with the Canadian Northern cutting the country from north to south, and the Canadian Pacific from east to west it is apparently destined to become the distributing centre for all the surrounding district.

Owing to the rapid expansion of the city, and the ever increasing demands on the electric light and water works plants it recently became necessary to take some steps to provide a method of meeting this demand. The City Council, therefore, engaged Messrs. DuCane, Dutcher & Company, of Vancouver, to locate, if possible, a water power site within a reasonable distance of the city; this firm succeeded in locating a suitable falls on the Barriere River, a tributary of the North Thompson, about 40 miles north of the city, capable of ultimately developing 10,000 h.p. and at the present time a dam has been constructed on this river and the contractors are already busy on the flume. It is expected to have the first 2,000 h.p. delivered at Kamloops in the spring of 1914. A sub-station to receive the incoming supply of 40,000 volts is also being built, together with a steam reserve plant consisting of two 750 kv.a. Curtis steam turbine units, and four 250 h.p. Babcock and Wilcox boilers. In the same building there is also being installed two motor driven turbine pumps, and one steam driven turbine pump having a combined capacity of 3,600 Imperial gallons per minute for the city's water works service.

Kamloops is also undoubtedly one of the best illuminating cities in the west, the outlying portions being lighted with series tungsten lamps of 80 c.p.; nearer in arc lamps are used, and on the main streets and avenues over 3 miles of "cluster" lights have been installed with the standards 100 feet apart.

A brief description of this cluster light system is of interest. It was designed and installed by Mr. C. L. Wain, chief engineer and superintendent of the Water & Light Departments of the city of Kamloops, who, after visiting several of the Pacific Coast cities, also came to the conclusion that the series system was more effective than the multiple system. Owing to the cement sidewalks being narrow, the stan

The beautifully illuminated streets of British Columbia's inland capital,

dards are placed on bases run out from the sidewalks, bringing the standards just clear of the pole line. These bases will, when the streets are paved, be jointed by a curb. The standards used were made by Messrs. Hutchison Bros., of Victoria, and carry 5 lights each on the main street and 3 lights each on the avenues. The lamps are 40 watt mazda with 12-inch alba globes. Lead covered wire run in 2-inch fibre conduit, laid in 8 inches of cement, was used for the circuit. Two wires are run, each standard being connected on alternate wires; this divides the system into two circuits, one of which is cut out at midnight while the other is left burning until daylight. The accompanying sketch shows different views of Victoria street, Kamloops.

Power Developments on the Abitibi

Work is well under way in connection with the first hydro-electric installation of the Abitibi Pulp & Paper Company at Iroquois Falls on the Abitibi River. At this point, according to Mr. Henry Holgate, consulting engineer, there is a head of 35 feet obtainable with a regulated flow of 6,500 c.f.s., which will give approximately 20,500 h.p., figuring 80 per cent. wheel efficiency. Two other falls on the same river and between Iroquois Falls and Lake Abitibi will give respectively 32 ft. and 36 ft. of head. These are named Twin Falls and Couchiching Falls, the latter being only a short distance from Lake Abitibi. The flow at these two latter points is only calculated at 6,000 c.f.s. on account of an increase in flow just below Twin Falls, due to the entrance of the Black river into the Abitibi. The total available horse power at these three points is, therefore, between 57,000 and 58,000 h.p., being approximately 20,000 at Iroquois Falls as stated above, 17,000 at Twin Falls and 20,000 at Couchiching Falls.

According to Mr. Holgate's report the conditions of regulation are very nearly ideal. The Abitibi Lakes have an area of 355 square miles and the area of the water shed tributary to these lakes is placed at 4,300 square miles. These lakes will form an ideal storage basin, for which purpose a temporary dam is being located at the point where the river Abitibi leaves the lake. The installation at Iroquois Falls, the first of these points to be developed, will consist initially of nine pairs of water wheels, each pair in a separate flume, and each of these pairs of wheels will be direct-connected to two wide pulp grinders. There will also be two other flumes, each with a pair of wheels, duplicates of those used for the grinders, but these will be direct-connected to electric generators for furnishing power to drive all equipment except the grinders, and for lighting. Each pair of wheels will be capable of generating, at full gate and 80 per cent. efficiency, about 1,500 h.p. The electric generators will each have a capacity of approximately 1,000 kw.

In all probability the developments at Twin Falls and Couchiching Falls will be entirely hydro-electric, current being transmitted to Iroquois Falls, which is considered at the present time the most satisfactory location for the manufacture of pulp and paper. When Couchiching Falls is developed it is planned that the permanent dam at that point will take the place of the present temporary timber structure for regulation purposes, as there is practically no fall between Lake Abitibi and the Couchiching Falls.

Mr. George F. Hardy, the engineer who has designed the pulp mill, reports steady progress to date. The upper cofferdam is now water tight and the lower one will be completed within a few days. They are practically ready for the foundations both of the buildings and of the dam, and the concrete work will start before the end of July. At present the materials for the concrete are being brought down the river by barge, but when the six-mile branch line of the T. & N. O. is completed, which it is expected will be about July 15, the materials will be brought in by that route. The saw mill is working at full capacity and is producing enough lumber for the forms for construction.

Contracts for machinery have been awarded as follows, to date:—turbines, Holyoke Machine Company; generators, Canadian Westinghouse Company; motors, Canadian General Electric Company; structural steel, Lackawanna Steel Company.

Recent Extensions in the City of Port Arthur

The City of Port Arthur have made a large number of electrical extensions during the past few months as indicated by the following items, which are of special interest as showing the continued activity of this progressive city.

Electric Light Department—20,000 feet of primaries and 40,000 feet of secondaries have been strung during the past year. Also 265 new services have been added, making a total of 3,089. There have been installed approximately 1,000 meters in the last twelve months.

Power Department—A 500 kw. motor-generator set has been put in operation in the Hydro-electric sub-station, and 30,000 feet of 4/0 d.c. feeders have been strung for the municipal street railway system. A new storage dam, at Current River, has been put into service, giving a regulation of 48 hours in place of 12 on the old dam. This dam cost approximately $30,000. The Hydro-electric Power Commission of Ontario have been asked to make a new survey of Dog Lake with a view to getting a supply of power there. In a former estimate prepared by the late Cecil B. Smith, he stated that power could be furnished from this lake to the city of Port Arthur at approximately $10 per h.p., high tension, and the citizens are looking forward to the development of this power, which would give industries a very low rate. The city are selling power at the present time at $25 for twenty-four hour service and $20 for ten-hour power, based on peak load. The present load is approximately 5,000 horse-power.

Street Railway Department—Ten new cars have been purchased of the "Pay-as-you-enter" type, and all the cars have been equipped with automotoneers and p.a.y.e. fare boxes, manufactured by the Toronto Railway Company. 80 lb. steel has been laid on a number of streets where permanent pavement has been placed. A main line extension approximately 2 miles long, and a belt line approximately 7 miles in length, single track, are in course of construction. The system operated 33 cars on July 1st, carrying 35,000 passengers.

Street Lighting Department—The street lighting system has been extended considerably during the past year in this city. 75,000 feet of No. 6 primary feeders and 145,000 feet No. 6 secondaries, with the necessary cross-arms, have been erected. There is now a total of 2,165 multiple incandescent lamps on the streets, 730—60 watt and 1,435—100 watt. The charge to the city for this service is $5 per annum for 60 watts and $8.30 per annum for 100 watts. This includes renewals, attendance and maintenance. The city is now one of the best lighted cities in the Dominion and the rate charged for the service is one of the lowest, if not the lowest, in Canada.

Telephone Department—This department have 2,501 telephones in service at date and have free exchange with the city of Fort William and the surrounding municipalities, making a total of over 5,000 telephones with which the customers have free connection. There have been laid, during the past year, 5,220 duct feet of underground conduit, and 8,700 feet of 400 pair cable. At the present time they have under construction a 1,650 line switchboard which will give a capacity of 3,750 lines. There is also in course of installation 1,780 feet underground conduit; 1,200 feet 400 pair cable; 8,000 feet of 200 pair cable; 7,200 feet of 100 pair cable, and 6,000 feet of 50 pair cable. The average calls per day are approximately 26,700.

Underground Distribution

For Small Cities and Large Towns—Single Core Cables Laid Solid in the Earth

By Mr. S. Bingham Hood

During recent years, the development of civic pride has created a widespread demand for an improvement in the appearance of the streets of our cities and towns.

Unsightly overhead electrical construction has, without doubt, been a strong factor in leading this civic pride to the point of demanding, and insisting upon, the removal of this class of construction, and substituting a system of underground distribution.

In our larger cities the load density makes overhead construction, in the congested districts, a difficult and expensive proposition; consequently economic requirements and esthetic demands are very apt to become coincident factors, and underground construction is not a burden upon the operating company.

In the case of our smaller cities, however, the problem is vastly different. The load density, and corresponding income, do not warrant expensive underground distribution; consequently yielding to the demand for this class of distribution must inevitably place an additional burden upon the community as a whole, or at least that portion of the community who patronize the local distributing company.

Some of our municipally operated systems are handling this proposition by charging the cost as a local improvement against the abutting property owners. This idea is somewhat amusing in that the cry for "all wires underground" becomes very much subdued when those immediately affected find they must back up the demands by cold cash.

Unfortunately for the private company, they have no practical means of dealing with the matter in this way; consequently their only resource is to grin and bear it until such time as the growth of the business has increased the net revenue to a point where all its customers are paying an excess profit sufficient to cover the increased overhead cost due to underground construction used only to supply a few. In other words, underground construction means maintaining a rate for current which, with overhead distribution, could have been reduced without lowering the net revenue below the point where a fair return on the investment is earned.

In the vast majority of cases, the local company are themselves, to a considerable extent, responsible for the underground construction demand, in that they have maintained a class of overhead construction so slip-shod and unworkmanlike in appearance that it is a continual eye sore to the public. Such construction, with present day standard fittings available at very moderate prices, is inexcusable; consequently a company which persists in offending by maintaining, and continuing to erect, a class of construction based on the old telegraph standard of thirty years ago, and looks as if it had actually been erected at about that time, deserves all it gets in the line of public criticism.

The writer had the pleasure of bringing to your attention last year a type of overhead construction which he believes comes as near eliminating the unsightly appearance of distribution lines as possible, except by actually placing them underground; and will take great pleasure in showing any of your members interested actual examples of the type of construction then advocated, and now standardized in Toronto. This construction should prove particularly interesting in that it can be immediately compared to old types of construction in the vicinity, and to recently erected lines on what are claimed by competing engineers to be the last word in overhead distribution.

The object of this paper is to endeavor to outline a type of underground distribution which has been tried out successfully in this city for these locations where the demand for "underground" has been such that no form of overhead construction would have been acceptable.

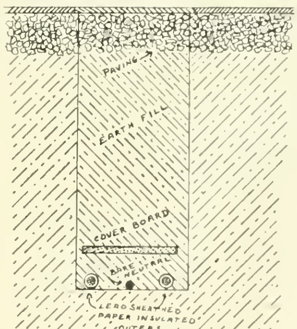
We will not attempt to go into the whole problem of general underground distribution, but will confine ourselves to the problem which so many of you are now facing; namely, the elimination of poles and wires from the main streets of your city.

This problem permits of locating your transformers on poles located on intersecting streets and terminating your high tension lines on these poles. The problem then becomes one of low tension distribution only, which involves no complicated conditions and resolves itself into a matter of striking a balance between first cost and reliability.

CLASS OF WORK.		COST IN DOLLARS PER FOOT									
		LABOR		CONDUIT		CONCRETE		REPAVING		TOTAL	
		DUCT	DITCH	DUCT	DITCH	DUCT	DITCH	DUCT	DITCH	DUCT	DITCH
SOLID SYSTEM	PAVED		.39						.30		.69
	UNPAVED		.22								.22
SINGLE DUCT	PAVED	52	.52	07	.07	.05	.05	.30	.30	.94	.94
	UNPAVED	.35	35	.07	.07	.05	.05			.47	.47
3 DUCT	PAVED	.22	.66	.065	.195	.028	.085	.17	.52	.49	1.46
	UNPAVED	.16	.48	.065	.195	.028	.085			.25	.76
4 DUCT	PAVED	.16	.64	.06	.24	.025	.10	.105	.42	.35	1.40
	UNPAVED	.13	.52	.06	.24	.025	.10			.22	.88
6 DUCT	PAVED	.12	.72	.055	.33	.02	.12	.07	.42	.27	1.59
	UNPAVED	09	.54	.055	.33	.02	.12			.18	.99
8 DUCT	PAVED	.10	.80	.06	.48	.016	.13	.05	.42	.24	1.83
	UNPAVED	.07	.56	.06	.48	.016	.13			.15	1.17
12 DUCT	PAVED	.07	.84	.055	.66	.012	.14	.045	.52	.18	2.16
	UNPAVED	.05	.60	.055	.66	.012	.14			.12	1.40

NOTE:—ABOVE PRICES EXCLUSIVE OF CABLE, MANHOLES OR HANDHOLES.

- FIGURE 1 -



- FIGURE 2 -

In our larger cities we find the original Edison Iron Tube System still in extensive operation; but being gradually displaced by a conduit draw in system. Here we see the condition of accessibility being given first consideration in the design. With the load density found in these congested centres, requiring extensive networks of feeders as well as mains, the relative cost of cables as compared to the housing (conduit) system is high. Consequently the possible saving by using a solidly laid system over that of a draw in system is not so important, and accessibility can be given preference over first cost. Table 1 gives the cost of conduit systems under average conditions of city construction in sand or loam. By reference to this, and assuming that for a large

*Read before the C.E.A. Convention.

city system an eight duct line is the average size we find a cost per duct foot of about 24 cents. A heavy feeder cable in this duct will cost about 80 cents, so that the duct system represents, excluding manholes, about 23 per cent. of the total cost.

Applying this to a small local low tension distributing system using a four duct line we find the cost per duct foot to be 35 cents, or $1.40 per ditch foot; to which we must add cost of a handhole about every 100 feet. This would bring the cost per ditch foot up to $1.65. The cable system for mains, using 250,000 c.m. lead outers and a 2/0 bare neutral would represent an investment of about 60 cents per ditch foot, or a total cost of $2.25 per foot of main; of which the conduit system represents over 70 per cent. This is the all-important problem for the engineer of the system in the smaller cities to solve; namely, is the accessibility feature worth increasing an already burdensome investment 70 per cent?

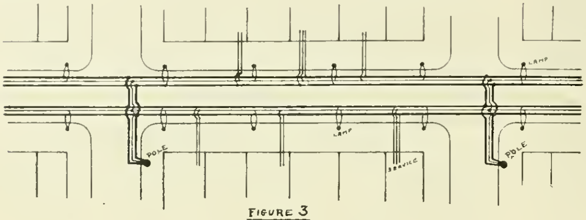


FIGURE 3

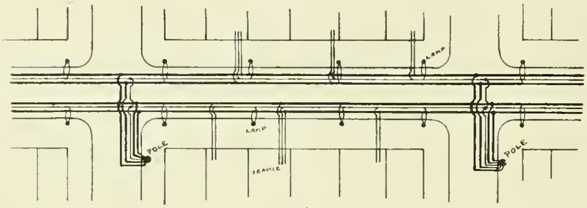


FIGURE 4

What could we save by laying our cables solid in the earth? By reference to the table and using the smallest size ditch, that suitable for a one duct line as being of the minimum width, and allowing 25 per cent. of the labor cost as representing that required to lay conduit with its concrete envelope, we get an approximate cost for a solid system as follows:—

Labor, per ditch foot	$ .39
Repaving, per ditch foot	.30
Cables	.60
Cover board	.03
Total	$1.32

This represents a saving over a conduit draw-in system of 93 cents per ditch foot, or over 40 per cent. Assuming that we can look reasonably well into the future as to load demands, which we usually can do in the case of substituting underground for overhead distribution in a small city, the main street of which has fairly well reached its final development, it looks as if this saving should be utilized if possible.

Lead cables laid solid in the earth are not subject to any deterioration other than mechanical injury, excepting what would exist if pulled into a draw-in system. For years and years past it has been common practice to lay lead pipe water services directly in the earth. Such services are maintained under identically the same conditions as a solidly laid lead cable system, and subject to the same chances as to chemical and mechanical injury. In addition they have the freezing element to deal with, particularly in our climate. Have the water works engineers found it necessary to lay conduits or other protective structures for these services, in order to give protection against mechanical injury or to provide for accessibility? Most assuredly they have not; therefore, why should we?

In England, the solid system of mains is almost universal practice and, at double our standard distribution voltage, is giving every satisfaction, and making it commercially practical to maintain an extensive underground network on load densities which would stagger the engineer of any of our smaller companies who might be called upon to face a complete underground proposition for his district.

The use of three core armored cables is the practice there, but this type of cable does not appeal to the writer for application to our conditions for the following reasons:

Reasons Against Armored Cable

First—The jute protection over the armor and between the armor and the lead sheath is bound to depreciate sooner or later, due to chemical action or mechanical injury. This leaves two dissimilar metals in close proximity in a chemically charged soil. Injury to one or the other or both, is bound to follow.

Second—In the event of earthing of the neutral and one outer, and alternating current being used, the armored sheath will cause an inductive drop which will prevent the other outer being continued in service and may cause heating which would ruin the entire cable.

Third—The advantage of continuing in operation one side of three wire system, when the other is in trouble, is of considerable value as affecting continuity of service. This is not possible with a three conductor cable and single conductor armored cables can not be used with heavy alternating currents.

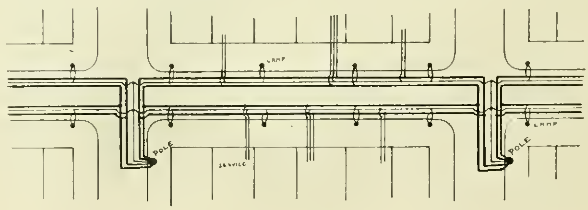


FIGURE 5

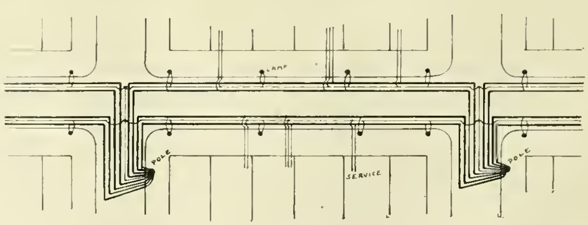


FIGURE 6

With the use of a solidly earthed neutral this conductor can be laid with bare copper, being simply in the form of a bond wire around the various earthing points located one at each customer's service.

We therefore require but two insulated and lead sheathed single conductor cables for a three wire system. The combined cost of these and the bare neutral will not exceed the cost of a three core armored cable, and we have all the advantages of two independent two wire systems as to reliability and continuity of service. In laying these cables, about four inches of earth should separate each conductor from the bare neutral, or about eight inches between the outers. The group of cables so separated should then be covered with from four to six inches of earth and a cover board of one inch rough lumber, corbolineum treated, laid down and ditch filled in. This gives a system of the utmost simplicity and one which any unskilled laborer can successfully lay with proper supervision. Fig. 2 gives a cross section of such a system and illustrates clearly its simplicity.

Now as to mechanical injury, which is the only one we have to deal with, as electrical injury with a solid grounded neutral and the most ordinary care in laying and jointing is practically eliminated with modern cable purchased under standard specifications from reliable manufacturers, on 600 volt rating.

Mechanical injury can occur in but one way — digging a hole down through the street surface to the cables. Anyone making such an excavation first hits the cover board, which not only requires considerable force to break through, but serves as a warning to almost anyone whose work makes him familiar with underground conditions along a city street.

Allowing that an unusual absence of brains does finally permit of getting through the cover board and down to the cables. The worst that can happen is a punctured cable which, in the ordinary small system, will blow the fuse, and resulting complaints would naturally lead to an investigation, which, with ordinary prompt attention, will catch the culprit before he has his ditch filled in. Repairs can then be made by stripping back the lead, re-insulating, and putting on a patch or split sleeve; or, better still, a split box which can be clamped around the cable and filled with compound. Now the chances of anyone cutting into the second cable after damaging the first are so slim as to be almost negligible.

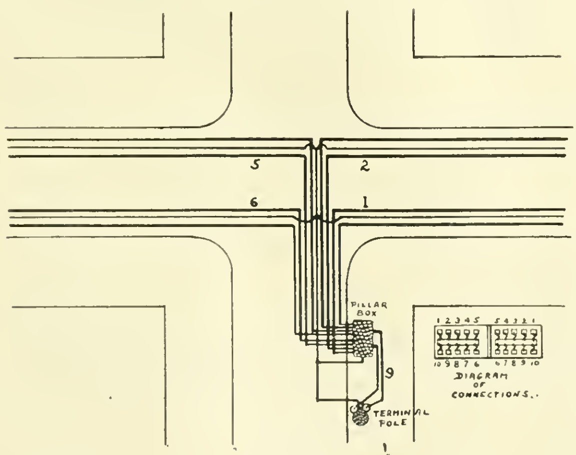


FIGURE 9

In the event of the puncture not blowing the fuses, the lead covering will burn away until it clears itself, in which case the ditch will probably be filled in and the damaged cable buried without repairs. This looks serious at first sight but, as a matter of fact, would only result in a small leakage which, of course, should be repaired if possible, but would not interfere with operation of the system if left in the damaged condition. To illustrate the trifling leakage which would occur in a case of this kind just consider the common driven pipe ground connection which so many of us have endeavored to use for neutral grounds on our system, and have found practically useless for this purpose. Here we have a length of pipe probably eight feet long and three-quarters of an inch in diameter, with a contact surface of over one square foot. Under the most favorable conditions such a ground will not pass more than ten amperes at 110 volts and under average conditions probably not more than two amperes. Now compare this area with the area of a cable core which would be exposed by being cut into by a pick or shovel and it is at once plain that we would almost require a milliammeter to detect the actual leakage current.

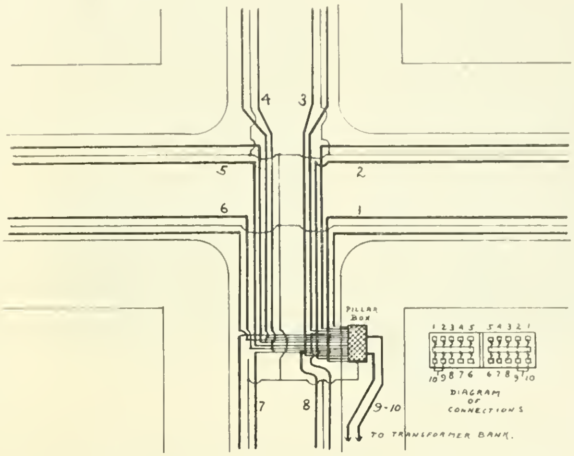


FIGURE 10

If we consider the unusual classes of injury, such as driving a bar through the street surface for attachment of derrick cables, blasting operations for deep sewer excavations, undermining for sidewalk vaults, earthquakes, and a thousand and one similar conditions which are in most cases improbable, the solid system will stand up better than a conduit draw-in construction. This is because the disturbance of a conduit line introduces a shearing action on the cables, while, in the solid system, the cables will give with each movement of the surrounding earth.

Now let us consider two other causes for damage to underground cables; namely, electrolysis and gas explosions. The first of these is due to stray railway return currents leaving the cable sheaths at definite points. In a conduit system these points usually occur at the hangers in manholes and where the cables are in contact with points in the duct line, as where cables touch the edge of ducts in bending around manholes and at joints in conduit where the cement has squeezed through and formed a little projection which is always more impregnated with moisture than other parts of the conduit. The old practice of preventing electrolysis was to insulate the lead sheaths from the earth, or at least try to insulate them. Usually the remedy was worse than the disease owing to it only being

possible to indifferently insulate at points in manholes open to inspection; consequently the leakage was transferred to unsuspected points back in the conduits and could not be detected until final breakdown had occured. The latest practice is to thoroughly ground all sheaths to earth and where distinctly positive to the rails to bond to these rails. This places the sheaths directly in parallel with the rails and permits them to carry a proportion of the return current continuously. Now with a solid cable system, all points of the sheath are in contact with the earth and the bare neutral is a continuous bond around cable joints or other weak sections. The earth acts as an excellent conductor of heat, and it is surprising the amount of return current that a pair of small cable sheaths will carry in this way without dangerous heating. Being uniformly earthed at every point there can be no sharp points of potential difference, and the entire system will drain itself without distress, under conditions such as would be found in connection with a tramway system for a small city, allowing that rail bonds were in fair condition. By fair condition, we mean sufficiently good to permit of ordinary operation of the tramway.

To illustrate the amount of return current which a cable sheath will carry in an emergency, the writer recently had occasion to investigate a conduit cable system where electrolysis was suspected. There were two cables in the system, each with a diameter over the sheath of about 2½ in. A bleeder cable was connected from these sheaths to the railway negative return cables, and ammeter readings showed as high as 600 amps. under peak load conditions, or 300 amperes per sheath. With this current the cables showed no signs of dangerous heating, even when carrying their usual currents up to nearly the rated capacity of their conductors. If these had been laid solid in the earth, probably no appreciable heating could have been detected. The simple solution of electrolytic troubles is found in providing an easy path for stray currents to leave the sheaths. In a solid cable system, the method of laying automatically provides this means at no additional cost.

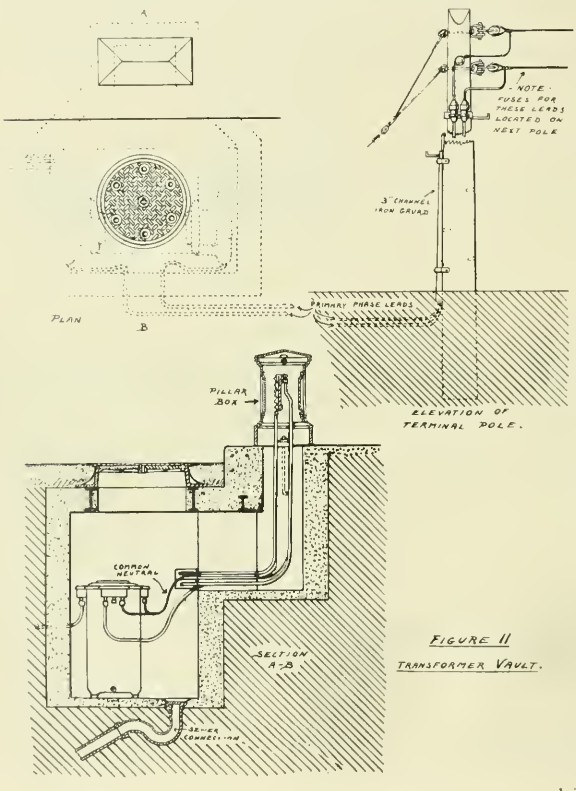


FIGURE 11

TRANSFORMER VAULT.

Considering the danger from gas explosion in manholes and conduits, a solid cable system eliminates the cause of such explosions as it goes without saying that explosive gas mixtures can not form if there is no space for them to form in.

Having, we trust, demonstrated that a solid system is as good as a draw-in system as regards reliability, and that it is cheaper as to first cost and superior in some details, it only remains to take up the question of relative cost in the event of additional cables being necessary, over the capacity which can be foreseen at time of construction.

Let us forget the general problem of underground distribution as applied to large cities, and consider only that of a main street system for our smaller city. A main in one block becomes overloaded and requires additional copper. Now the natural thing to do is to run a sub-feeder from the nearest intersection, and tap into our existing mains at about the centre of the block. This means digging up one-half of our ditch in this block at a cost of 69 cents per ditch foot as per previous estimate. This means an increased average cost for the entire block of one-half this per ditch foot, or 35 cents.

Now if we had foreseen this condition at the start, and had laid a conduit system to provide for it we would have selected a six duct line. We probably would not have known from which intersection we would run our sub-feeder, and consequently carry the six duct line throughout the entire block, at an added additional expense of 19 cents per ditch foot.

Our original 4 duct line has been shown to have cost us 93 cents per ditch foot more than the solid system, so that to provide for this draw-in extension we have an excess investment of $1.12 per ditch foot made in order to save a possible future investment of 35 cents per ditch foot. Does not this clearly illustrate the desirability of the solid system of construction for small city construction under paved streets or sidewalks? If so, its desirability for use in residential sections where mains can be laid under grass plots and boulevards, with the elimination of repaving costs, is beyond question.

Before considering actual details of distribution for such a solid cable system the writer desires to mention actual results obtained from a system of this kind in daily service. There is in Toronto today somewhat over 6,000 feet of this type of mains which have been in use for over two years. This was laid in new residential streets where building construction was in process and the certainty of three ditches being dug over our main for every new dwelling erected. These streets are now solidly built up and no additional ditches can be expected except for repairs to services already laid. Under these severe conditions no interference or failures have occurred and in opening up for new services from time to time no depreciation is visible on the cables, which are in condition to-day equal to the day they were laid. It may also be interesting to note that this construction was in unfinished boulevards with sandy soil and outers were only of 2/0 cross section. The cost was about 80 cents per ditch foot or $1.60 per foot of street, mains being laid on both sides. The original supply for these streets was by overhead lines at a cost of about 30 cents per foot of street. This means that under the most favorable conditions underground construction will run not less than five times that of overhead.

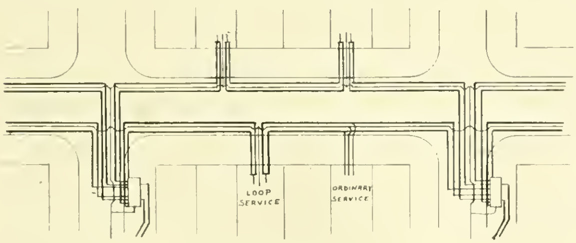
Coming down to actual selection of the system of distribution, we have two things definitely fixed in most cases; first, the supply to be alternating current derived from pole transformers erected on intersecting streets; and, second, a system of ornamental street lighting will be required in conjunction with the commercial system.

For street lighting of this kind the multiple system has definite and distinct advantages over any series system, and should be used in every case where ornamental posts with underground supply parallel the commercial mains. To obtain the maximum economy and simplicity we must connect these street lanterns to our commercial mains, which means individual control of the posts by the patrol system. At first sight this may seem somewhat crude and like going back to the old gas lamp days. However, just figure out various schemes of remote control for yourselves, and, if you find one which is cheaper than the one-boy power switching system, we will all be very much interested to receive details of same.

The simplest system of distribution is shown in Fig. 3, being a three wire main with service taps taken off for commercial loads and street lamps and the transformers feeding in through simple tapped branches at intersecting streets. The defect of this system is that a fault will shut down one, or possibly both sides of the system until it can be located or cleared.

Fig. 4 shows this defect partially overcome by laying each side of the street as separate sections, multipled at the pole head.

Fig. 5 shows a similar arrangement where each block is maintained as a separate unit. This is not advised owing to all street lamps in the block being out if both sides of the system fail for any reason.



- FIGURE 12 -

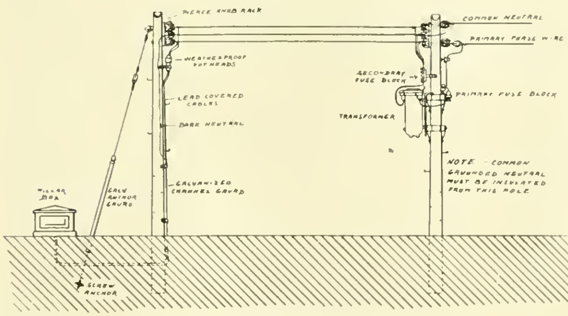


FIGURE 14

Fig. 6 shows the necessary arrangement to provide against extensive outages due to trouble on any section of the mains and provides for sectionalizing of the main on either side of any block. With this arrangement each block is fed from each end, transformers being located at the extreme ends of the system in order that no block may have its supply limited to one source. This arrangement permits of opening any main for repairs or changes without interfering with the supply to any customer.

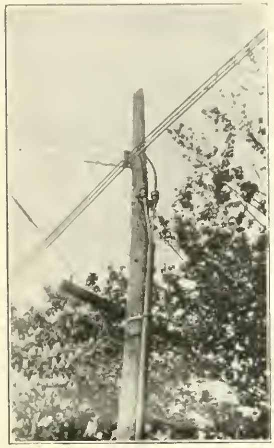


Fig. 16

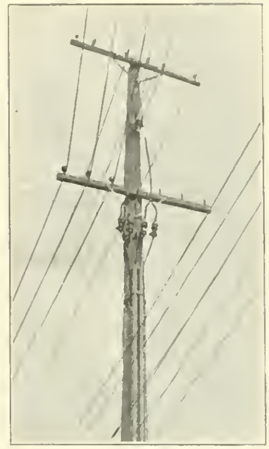


Fig. 1

This latter arrangement is a trifle more expensive than some of the simpler plans, but the additional expense is well warranted by the added convenience of being able to quickly sectionalize trouble and thereby get service restored to the majority of customers in a very short time. The trouble with such a scheme is the difficulty of making a good job of bringing the eight cables up the terminal pole, requiring four pipes or protecting troughs and a cumbersome paralleling bus arrangement on the pole top. To overcome this the "Pillar Box" has been designed. This box is supported on two concrete piers going down below frost line, the box being secured by a pair of anchor bolts embedded in the concrete. The standard box is what is known as a ten stub box, terminals being provided for ten outgoing leads on both positive and negative sides of the system. Each polarity is kept separate with a removable asbestos board barrier intervening. This design makes it easy to work without danger of short circuit and provides a quick and easy means of testing and sectionalizing without necessity of going up the pole or opening subway boxes, the latter being a tedious and unpleasant task in winter weather with everything below ground covered with a layer of snow and ice. Fig. 9 shows the method of connecting one of these pillar boxes for an intersection, such as shown in Fig. 6, the box being preferably located on the curb line of the main street. Fig. 10 shows a similar box connected for an intersection on which underground supply is used on both the main and intersecting streets. In this application the feeder line is carried over the intersecting street to the point where transformers are located overhead; or if an extensive system is maintained, the transformer may be in an adjacent vault and the high tension supply cable laid underground from the nearest pole terminal, where high tension fuses are located. This type of construction does away with all necessity of getting to the transformer vault for fusing or disconnecting and forms an ideal method of distribution for a fairly large city, particularly if a common neutral primary supply system is maintained. With such a system a small single conduc-

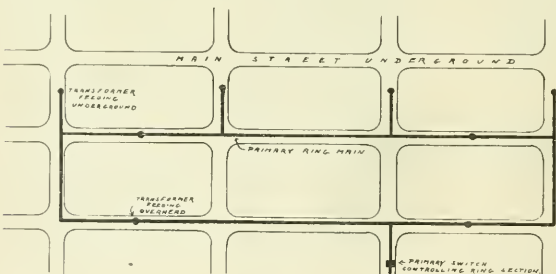
tor primary cable is all that is necessary. Fig. 11 shows a section and plan view of such an arrangement.

The cost of these pillar boxes complete, with hot galvanized finish throughout, is about $100 each, or approximately the cost of trying to get the entire bunch of cables up the terminal pole.

In the case of long or important business blocks it is often desirable to be able to further sectionalize a main in the event of trouble. This is readily accomplished by running in what is known to us as a "loop service" and consists of simply cutting the main and carrying both ends into the building and connecting same at the service entrance through a loop box. The service wires are then, of course, the full size of the main. In general the loops are located in the more important buildings and not only furnish a ready means of sectionalizing, but allow of this important customer being supplied from either end of the loop while locating and repairing a fault. Fig. 12 shows the method of looping.

The details of terminal and transformer pole arrangement for the system should have careful consideration, as they form the heart of the entire net work. Cables must be provided with weatherproof terminal bells or "potheads" and fuses are necessary unless the cables lead directly to a pillar box. The transformer should not be located on the cable pole, but on the next pole on the line, in order that linemen may not be called upon to handle a "death trap" caused by high tension apparatus being located on a pole which is "grounded." The general arrangement is shown in Fig. 14, and details of cables and "terminal bells" in Figs. 16 and 17. The latter is a "loop" terminal and would apply to the extreme ends of a main street, where the two mains, in place of entering a pillar box, are carried up the pole.

With a system of this kind all power demands must be met with single phase motors, which usually is not difficult owing to individual motors in the business section seldom being of large size. The principal objection to motors of this type usually comes from the customer, owing to their higher cost as compared to multiphase type. If it should



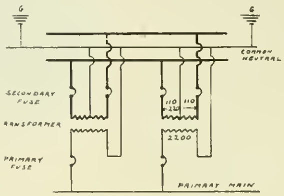
-FIGURE 18-

be necessary to meet this situation the supply company can well afford to pay the difference rather than yield to the demand for polyphase supply on which the excess investment for mains, services and meters, will be considerably in excess of the difference in the cost of the two types of motors.

Several systems of polyphase underground supply have been tried out, but, in the writer's opinion are objectionable. One of these is the four-wire system, giving 115 volts from each of the three insulated phase wires and the common neutral, and approximately 200 volts across phases. This system requires a motor voltage which is not standardized and requires balancing in three sections in place of two with the ordinary three-wire single phase system. Copper cost is also higher than with single phase.

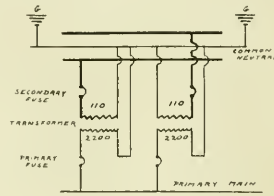
The other system is a straight three phase 550 volt delta on which dry type single phase transformers must be installed on the customers' premises for stepping down the power voltage for lighting. The use of such a system is a twenty years step backwards. The cost of transformers alone will offset any possible saving in copper, to say nothing of core losses and added fire risk to the customer's premises.

In conclusion we would call attention to the desirability of having the primary supply for the suggested underground syste marranged as a ring main. The secondary, to get full advantage of diversity factor and consequent low copper and transformer costs, must be interconnected. With a single line primary a break in the line will cause considerable trouble in the low tension network, owing to the transformers on live side of break not only feeding their own load but



IMPROPER METHOD OF BANKING A PAIR OF TRANSFORMERS.

-FIGURE 20-



PROPER METHOD OF BANKING A PAIR OF TRANSFORMERS

-FIGURE 21-

supplying step down current which will go through the intervening mains an dstep up again in an attempt to supply the load beyond the break. This primary ring may be arranged as shown in Fig. 18; or may be a ring encircling the underground section, in which case the pillar boxes may be dispensed with and loops carried up on intersecting streets on both sides of the main street. With moderate loads this will involve using motor transformers of smaller sizes, with corresponding increased cost. If, however, the load at each intersection is in excess of 15 kw. then the additional cost will not be appreciable. This is due to the fact that a 15 kw. transformer is about as large as one can safely use as a unit on general distribution, so that for heavy loads two transformers at each intersection would probably be required. In this case it makes little difference whether they are on the same side or opposite sides of the main street. Just a word of warning, however. If you require two transformers to feed into the same point don't connect them in multiple, as in Fig. 20. If you do, don't be surprised when they both drop their load at the same time, which they will ninety-nine times out of a hundred. Connect them one to each side of the three wire system, as in Fig. 21, and let each take care of its own part of the network.

Personals

Mr. C. A. Howe is spending a few weeks in Eastern Canada in connection with the business of his company.

Mr. S. L. B. Lines, president and managing director the Chamberlain & Hookham Meter Company, Limited, is on a six weeks business trip to England.

Mr. N. E. Bell, who was formerly electric wiring inspector for the Ottawa Fire Insurance Underwriters has been appointed to a similar position by the Ottawa city council.

The Care of Graphic Meters

A Practical Article on their General Use, Testing and Repair

By Mr. G. D. Gratton

What is a Graphic Meter? As understood by the electrical profession, it is an electrical measuring instrument which indicates the condition of the circuits, and arranged that this condition may be drawn or traced on a chart by means of a pen or other marking device connected with the measuring element, thereby making a graphic representation of the condition of the circuit. The chart is marked or scaled to represent the value of units of which it is desired to make a record, and is also marked to show the time of the day, in order that the condition which existed in the circuit at any previous time can be ascertained. The chart is caused to move under the printing or pen mechanism by means of clockwork.

There appear to be several different titles for denoting Graphic meters, such as Graphic Curve-Drawing Meter, Graphic Recording Meter and Graphic Meter. Just which is the most correct title seems to be largely a matter of choice. The writer believes that the title Graphic Meter, which is the shortest, is also as expressive as any, for the reason that when the word "Graphic" is used it is understood that a Graphic meter is meant and not an Indicating or Integrating meter.

General Principles and Selection of Meters

The principles of the measuring elements of graphic meters are the same as those used for switchboard indicating and portable instruments, as follows:

The Kelvin Balance, the Siemens Dynamometer, the Moving Iron, the Induction, and the D'Arsonval. The most common are the Kelvin Balance and the Siemens Dynamometer, which are generally used for alternating-current voltmeters, ammeters and wattmeters, and in some makes for d.c. voltmeters. The dynamometer, moving iron and induction principles are used in various makes for voltmeters, ammeters, power factor, and frequency meters.

Graphic meters may also be said to be of two types, that is, the relay type and the direct-acting type. In the relay type the measuring element does not do the work of operating the pen, but closes a set of auxiliary contacts which close the circuit through the relay coils, or solenoids, that operate the pen. This keeps the pen friction, etc., away from the measuring element, and tends towards greater and longer accuracy, due to lighter moving elements; also the instruments do not require so much power to operate, that is, the shunt losses will be much less, as the instrument does not require as great a torque to operate the pen. It also means considerable saving in transformer capacity to operate the instrument.

In the direct-acting type the measuring element operates the pen directly on the chart, so that the moving coils are obliged to have a large torque in order to overcome the pen friction, etc. This means high shunt losses, and in some makes a heavy moving element. In one make of graphic with a high torque, the moving element weighs over half a pound, and the makers claim that this is done in order to give sufficient damping to the moving element. It was found, however, that unless the instrument is cery carefully adjusted, the pen did not follow the fluctuations of a fairly steady load, and on a fluctuating load did not follow the extreme variations in the load, but gave a good average curve of the load. This would be an objectionable feature in some cases and in others all that could be desired.

One well-known make of graphic meter of the direct-acting type, the potential or shunt coils require 100 watts each. In the case of a poly-phase wattmeter this would mean a shunt loss of 200 watts. This is a very high shunt loss compared to another well-known make operating on the relay principle, the shunt loss of which is about 8 watts and the power required by the solenoids or relay coils 25 watts, making a total watt loss for a polyphase meter of 41 watts.

The selection of a graphic depends on several conditions, such as the nature of the load, the terms of the contract, and the accuracy by which the load must be measured. If the charges are based on the indications or readings of the graphic, then one should be chosen that has good accuracy and that will remain accurate, even if it is the most expensive. On the other hand, if the graphic is merely intended to show the nature of the load, or to indicate when a peak or contracted load has been exceeded, an instrument that is not so accurate, and probably cheaper, may be used.

Paper or Chart Speed

The speed at which the paper shall travel is determined by the character of the load to be measured and the duration of the peak. This refers more particularly to wattmeters. For instance, a lighting load with a slowly rising and falling peak and generally a peak of rather a long period, a slow paper speed may be used, say 1 in. per hour, with good results. For another example, take a power load consisting principally of mill machinery on which the load is intermittent, such as rock crushers, air compressors, pulp grinders, conveyors, etc. In this case the load will be of a fluctuating nature and the peaks of short duration and will likely occur quite frequently. If a slow speed chart is used a broad line will be traced, due to the fact that the lines made by the pen will overlap, and the centre of the line will have to be taken as representing the peak. On the other hand if a high speed paper is used the curve will be extended or drawn out and the intervals between the peaks plainly distinguished. If in this instance the contract peak was 10 minutes, it would be better to use the slow speed chart, and again, if the same load was contracted for on a one minute peak it would be necessary to use a high speed chart in order that the cruve would not be crowded and the peaks overlap. It would be a difficult thing to measure a one-minute peak on a chart having a speed of one inch per hour, as, in most cases, the thickness of the line drawn by the pen would represent a time interval of more than a minute when scaled or measured on the chart, while the actual peak might have been less than a minute. For a one-minute peak a chart speed of not less than four inches per hour should be used. In general, a chart speed of $1\frac{1}{2}$ or 2 in. per hour will suit the majority of cases, and will allow a peak of short duration (not less than five minutes) to be scaled off the chart with accuracy.

Another point that should be borne in mind is whether it is desired to know the extreme variations or momentary peaks of the load, or the average load. This refers to such loads as motor driven air compressor with rapid unloaders, mine hoists and other intermittent loads. On a load of this nature a curve traced by a meter with little damping would be rather broad and uneven, depending, of course, on variations in the load. On the other hand, a meter in which the damping could be made very heavy would not follow the momentary fluctuations, but at the same time if the peak continued it would indicate the maximum.

A meter that uses a fairly wide chart, say 5 in. or more, is better adapted to close and accurate reading than one using a narrow chart. Especially is this so in the case of high capacity wattmeters and ammeters. The thickness of the line drawn by some pens may represent a value of 100 kw. or even 500 kw., and the line would have to be very carefully scaled in order that the company may not either over or under bill the customer.

*Presented before the C.E.A. Convention.

Scale Capacity

In choosing the scale capacity of a graphic meter it should be so chosen that with the average working position of the pointer or pen it will be at least half way across or over the chart. This tends to better accuracy in reading, and in the case of an alternating current wattmeter this would allow it to operate on a load with a low power factor without overloading the current windings and still keep the pointer well up on the scale; for instance, a 200 kw. load is to be measured, the power factor being probably about 75 or 80 per cent. An instrument with a scale capacity of 400 kw. would be chosen, allowing for small increased load and the low power factor. This is quite an important consideration. It is a big mistake to set up any instrument that has a large scale capacity and operated so that the pointer does not move very far from the zero point, for the reason that no measuring instrument is accurate when used so that the pointer is not deflected more than a quarter of full scale value (none of the manufacturers will guarantee their instruments when used below this value); at the same time they should not be operated at more than three-quarters or four-fifths of full scale value for the same reasons as above. In the case of wattmeters there is another point to be taken into consideration, that is, the power factor of the circuit. For instance, an instrument whose full scale value is 400 kw. is operating on a circuit which requires 300 kw. at 75 per cent. power factor. In this case the pointer would be operating at three quarters of full scale value, but the current coils would be operating at full current value. If the load increased to 400 kw. at the same power factor the current coils would be overloaded, which would tend to cause an incorrect reading. Also if the instrument is operating from the secondaries of current transformers, there would be another error due to the transformers being overloaded, as nearly all a.c. instruments are operated from secondaries of either or both current and potential transformers. It is the best practice to select transformers suitable for the present load, allowing for 50 per cent. or even 100 per cent. increase in load, and when that value has been reached change the transformers for larger ones. As it is only the current transformers that will have to be changed it will not be a very expensive operation. There are, of course, circumstances and conditions which would not allow of this, so that transformers large enough for the maximum capacity would have to be installed in the first place. When this is done it will necessitate changing the value of the scale. This is not a complicated operation, and if it cannot be done by the man in charge of the meters it can be sent to the manufacturers. The chart will also have to be given a new value to agree with the new scale. All that is necessary is to send a sample of the old chart with the new values marked on it to one of the printers that do this kind of printing. There are several in the field. With one or two exceptions the company with which the writer is connected uses all 5 ampere, 100 volt, graphic wattmeters having a full scale value of 1 kw., and has the charts printed to suit the transformers with which the meter is used, making our own scales and samples of the chart for the printer to work from, or if we do not want to have a special chart printed we use a chart having a value of 1 kw., and multiply the readings by the ratio of the transformers.

Performance

For satisfactory performance or operation, graphic meters require more careful attention than probably any other kind of instrument in regular daily use, for the reason that there are more details to get out of order, and as the interior is generally easily got at, it is as easily damaged by Mr. Paul Pry. This and carelessness is the cause of most of the trouble with graphic meters, and it is very doubtful even if very careful instructions were given the operators in charge of the switchboard or station that the trouble would be very greatly reduced. From the writer's experience the majority of operators do not remember verbal instructions for longer than it takes to tell them, and seldom look at printed instructions. It is by far the better plan to let one man look after the graphic meters, even if these is only one meter on the system. He will become well acquainted with the instruments in time and know how to handle them, doing better and quicker work and the instruments will give better satisfaction than when every Tom, Dick and Harry has a crack at it.

Repairs and Maintenance

This requires a good deal of skill and patience. As a large portion of the work is light and delicate, it should not be attempted by anyone who has not had previous experience in light repair work. The person undertaking this work should also be a pretty fair mechanic and know what the various parts are for and not be guesing at it; in short he should thoroughly understand the principles of the instrument he intends to repair. This also applies to other instruments than graphic meters. The question of how much repair work should be done on the job and what should be sent to the shop can only be answered by local conditions. If a company has a considerable number of instruments in service it is by far the better method to keep one or more spare meters on hand so that in case an instrument breaks down on an important customer it can be changed. This will save a loss or interruption in charts, and what is more important, a probable loss in revenue, due to a peak not being recorded. This same peak might very easily pay the cost of the extra graphic. In addition to the extra instrument a spare clock and several of the parts that are likely to require renewing should be kept on hand so that repairs can be quickly made. Generally speaking, only the smaller kind of repairs should be made on the job, such as replacing jewels, pivots, suspension wires, winding contacts, cleaning penpoints, etc. It will be found cheaper in most cases, where it is necessary to repair the clocks, to change them and do the repairing in the shop. Also in cases where it is necessary to do any recalibrating due to burn-outs to the leading-in springs, resistances, etc., it is better to remove the instruments and do the work in the shop. It is a hard job at the best to calibrate a graphic meter on its load, as the load is almost certain to be more or less variable, and even if a temporary load is rigged up it would have to be regulated in some manner, and it will take a good deal longer to do the job, and it will probably not be as good a job, as if done in the shop where everything is convenient. It will nearly always be the cheapest, even if it does mean an extra trip to reinstall the instruments, to repair it at the shop. An argument that might be used against this is that the calibration might become changed in shipment. This is almost entirely a question of packing. The writer has calibrated and shipped graphic meters without the slightest change in calibration. At the same time he has seen instruments seriously injured through careless packing.

Cost of Repairs

This is an item that should be given plenty of consideration. It is very poor policy to buy a graphic that, while the first cost is low, is all the time in need of repair. This does not necessarily mean replacing broken parts but may mean frequent checking, resetting zero, repairing the rewinding apparatus for the used chart, cleaning relay contact points, etc. With this company the largest item in the cost of repairs is the labor. With some companies transportation is a large item. The cost of actual new repair parts is not very great, the largest item in this case being new pens. As stated above the largest item in the cost of repairs is labor. In a way this may not be strictly true, as with some

companies the largest portion of this item is the time it takes to get to and from the job, for the reason that some of their customers, substations or power houses are some distance away from headquarters. So far as the time to do the actual work of repairs is concerned, it is not a large item, being from 1½ to 5 hours. The average time might be placed at 2 hours. As stated above, any job that is likely to prove a big one is sent to the shop and in this case the labor or time may be anything from one-half to several days.

The cost of doing various kinds of repairs, as found by the writer, is given in the following list:—

Cost of Repairs—Labor Only

Hand-wound Clocks	$1.60 to $4.00
	Average $2.00
Motor-wound Clocks	$0.75 to $3.50
	Average $2.00
Clock Motor	$2.00
Paper Mechanism	$2.00 to $6.50
Replacing Pivot	$1.80
Repairs to Pen	$1.00 to $2.00
	Average $1.80
Dotting Mechanism	$1.50 to $4.00
	Average $2.00
Pen-lifting Mechanism	$1.50
Pen Shaft Bearings	$1.00
Cleaning Jewels and Contact Points	$2.00
Repairing Resistances	$5.00
Repairing Control Circuit	$2.00

The most common of the troubles which may be looked for and their remedies are given below:—

Stoppage of Hand-wound Clock—This is generally due to the clock getting dirty and sticking, and as a general rule they may be cleaned by washing thoroughly with gasoline or benzine with a small, long-bristle paint brush. After washing, oil thoroughly with watch oil. Nye's watch oil is very good for this work. Some makes of hand-wound clocks will stop if wound too tight, as the springs seem to bind instead of unwinding. Remedy: Remove the escapement and start the clock unwinding, being careful not to let it unwind too fast.

The stoppage of motor-wound clocks may be due to several reasons, the chief of which are broken winding contact, winding dogs, and the pin in the main-spring shaft that moves the winding dog. The only way to satisfactorily repair these is to put in new parts, as they are not expensive.

Zero Shift—By this is meant the shifting of the pen from the zero line. This company has found this to be a common occurrence in one make of graphic meter. It may be due to several causes—change of temperature, shifting of control springs, violent overloads or surges, misplaced pen or chart, friction, etc. In some cases where the temperature effects are noticed, it is due to the fact that the instrument is located in either a hot or cold place, such as a substation with no means of heating in the winter time, or in the hot weather poor ventilation. This is almost certain to cause a change in the tension of the controlling springs. The only remedy is to adjust the springs to suit the temperature each time there is a considerable change. It goes without saying that a meter of this kind should not be on a load that it is desired to measure with any degree of accuracy. In the case of the relay type of meter, this trouble very rarely develops, and as there is always provided a mechanical means of correcting it, it is very little trouble to do so.

If the control springs have shifted they will probably be found loose. Move them till the pointer comes to zero, and tighten.

If a violent overload has been the cause of it, the pen shaft will probably be found bent. Straighten shaft until the pen comes to zero.

Misplaced pen and chart can easily be detected by an examination, and is as easily fixed.

Friction may be caused by broken jewels, pivots, pen bearing too heavily on chart (this applies principally to the direct-acting type), in one type the suspension wire may have stretched or moved and the moving element be rubbing on the lower jewel.

Meter Does Not Register the Correct Amount of Energy Passing in the Circuit—This may be due to several reasons—improper connections, blows fuses, grounds on the secondary of the current transformers, burnt-out or open-circuited potential coils, burnt-out or open-circuited resistances in series with the potential coils. The best way to locate the trouble is to start by testing with a lamp to see if the potential is on. If this is found off, the fuses are burnt out. Replace with new. If the potential is found to be on, try disconnecting the potential leads to the meter and see if there is a spark when the lead is touched to the meter terminal. If there is no spark, the potential coil is almost certain to be burnt out (and whether this will have to be shipped to the manufacturers or repaired by the company depends on the ability of the repairman). If there is a spark, the potential coil is O.K., and the trouble will most probably be improper connections. Trace the connections and reconnect if necessary. If the connections are O.K., look for a ground on the secondary of the current coils or wiring. The effect of a ground on the current wiring is to shunt the current transformer and cause the meter to read low. This is especially so in the case of polyphase circuits where two or more current coils are used.

There are numerous other causes of trouble and their remedies, but it would require too much space to mention them here.

Cost of Operation

This is the cost of repairs, testing, charts, current losses in potential and control circuits, ink, etc. As to which is the largest item depends on local conditions, though, generally speaking, it is the cost of repairs and testing that will be noticed by the management and considered as the largest item, even though the largest cost may easily be the cost of the current required to operate the instruments. Consider the case of a polyphase instrument that requires 200 watts in the potential circuit; this loss goes on every hour, year in and year out, and with energy costing 1c a kw. hour, means a loss of $16.50 a year, and in a station, or a number of stations, where a large number are used, this loss amounts to a considerable amount, and is worth considering. The cost of testing depends on how often the instrument is tested and the cost of transportation. The same applies to the cost of repairs. With our company the largest part of this item is transportation and the time getting to and from the job.

The cost of charts varies with the kind and style used and the quantities ordered. The cheapest way to get the charts is to buy a year's supply for all the graphics in use. By doing this a much better figure can be obtained than by purchasing a few at a time.

Testing

A large chapter could be devoted to this subject and then it would not be any too fully covered, but the writer will only make a few general remarks, relating chiefly to wattmeters, of which there are more in use than probably all the other meters together. The following remarks apply to polyphase instruments.

Shop Testing

A convenient rack should be made up, on which a graphic meter can be quickly hung. This company uses a hardwood board arranged on the front end of its service meter testing table, and drilled so that any make of graphic meter can be mounted in a few minutes, and the terminals, connections,

etc., are easily gotten at for repairs and recalibration. The board itself is fastened to the testing table by means of straps and bolts with thumb screws, so as to be easily removed or set up. The testing table itself, is made of heavy dry pine, well shellacked and varnished. The current supply is 3-phase, 3-wire, 100 volts, 60-cycle, supplied from a bank of 10 kw. transformers and 150 volt, direct current supplied by a 6 kw. motor-generator set. The table is so arranged that it can be used as two independent boards for single phase work, or can be combined for 3-phase work. Any power factor from zero lagging to zero leading can be obtained. From the diagram of connections, shown herewith, it would appear to be rather complicated, also there is the possibility of making dead short circuits. As a matter of fact, in actual operation, the board is very simple, and if a short is made it does no harm, as the board is protected by circuit breakers which are very effective. These have operated time and again on a short when a lamp fuse did blow. In addition to this the standards are protected by a switch that short-circuits the current winding, making it impossible to do any serious damage. No testing table of any description should be without circuit breakers, as they are the very best of protection. It would take too much space here to describe the testing table in detail, so that the brief description given will have to suffice, any more than to say that it was designed expressly for quick and accurate testing of single and polyphase watt-hour meters, and, of course, can be used for testing any other kind of meter.

Every graphic, when received from the factory, should be tested, for accuracy of scale indications, correctness of chart ruling, balance between elements, and thoroughly examined for defects of any kind. To test for scale accuracy, connect in series one element at a time with a standard indicating wattmeter on a single phase circuit. The indications of the standard wattmeter, multiplied by the ratio of the transformers with which it is intended to use the graphic, should equal the graphic reading if it is correct. If no transformers are to be used, then the indication of the standard should be the same as the graphic; make a note of the errors, if any, and then test the other element. If there is no difference between the readings of each element, then they are equally balanced. If the difference is very great, it should be corrected by either adding a little more resistance to the resistance in series with the potential circuit that reads the highest, or taking a little away from the low reading element. Which of the two adjustments should be made depends on whether the high or low reading is correct; if the high reading is correct, then the adjustment should be made on the low reading element; if the reverse is the case, then adjust the high reading element; if both elements are high, then both will have to be adjusted by adding more resistance. It should also be tested on zero power factor if possible, but as it is very easy to get a 50 per cent. power factor on a 3-phase testing circuit, it will generally be more convenient to test at 50 per cent. power factor, and if the graphic is found correct at 50 per cent., it will be correct at zero power factor or vice versa. It is very important that a polyphase wattmeter should be correct on power factor, and it is equally so that they should be correctly balanced. It is not enough to think that if one element is a little low and the other just as much high, that the average error will be zero. This would be the case if the power factor of the load were 100 per cent., but as this is never the case on a power load or even a lighting load, there will be an error depending upon the power factor.

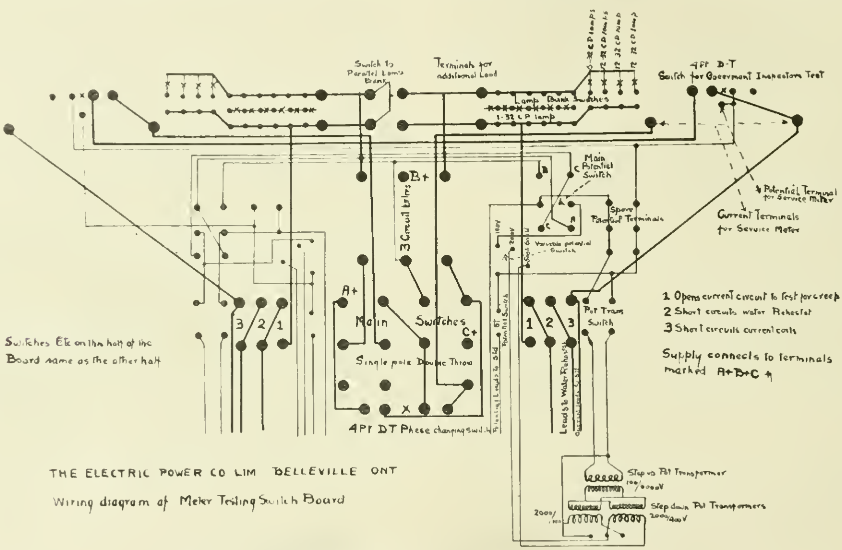


Diagram of Connections—Meter Table for Testing in Service

It should also be pointed out that both potential circuits should be connected in parallel when making these tests, the same as is done in testing watt-hour meters, for the reason that in some makes of graphics one element affects the other, while in other makes there is no interference between elements, so that it is the safest to connect both potential circuits. Care should also be taken to see that the current is passing through the windings in the proper direction, otherwise there will probably be an error that would not exist if the instruments were properly connected.

Another method of testing the balance between elements is to buck them; that is, connect one element to read backwards, but this is not as satisfactory as testing each element separately, for the reason that the pointer may come to zero and yet the elements are not balanced, as would be the case if one element was exactly as much too low as the other is too high.

The charts should be examined to see that the ruling is correct as to the spacing, etc. If not correctly ruled there will be an error in taking the reading off the chart.

The meter should be very carefully examined for mechanical defects, such as loose connections, improperly adjusted clocks, winding attachments, re-rolling and paper mechanism. If none of these troubles can be seen the instrument is in apparently good shape. However, it is a good plan to set it up and let it run for several days in order to bring out any defects that exist.

This generally consists of comparing the readings of the graphic with a portable standard, and noting the error. The test is generally made by connecting the standard in service with the instrument to be tested, on the same load, using the same instrument transformers when they are used, which is generally the case, though in some cases it is necessary to use a separate set of portable testing transformers. This is only done if there is any reason to doubt the accuracy of transformers to which the graphic is connected. It is much more convenient to use the same transformers. If it is desired to test the instrument as a secondary meter on an artificial load, the switch board lights may be used or a portable lamp bank.

A few words might be said about the method of connecting the standard in series with the meter under test, particularly when using the same current transformers. Until quite recently very few power boards were equipped with any kind of means for testing, and the tester had to do the best he could to connect in, and frequently got a shock for his trouble. It is warm work and dangerous, to connect in series with the secondary of a current transformer, as a slip may mean a violent shock and injury to the instrument and transformers. In addition to this, everything else is alive, and it is a very awkward proposition to wear rubber gloves, as the wires, terminals, etc., are small. The writer has seen several accidents of this kind. In one case three instruments were damaged, and the tester's hand severely burnt. Very few current transformers are provided with suitable or convenient means of short-circuiting them if necessary. One manufacturer provides a piece of solid copper wire, which always breaks after it has been used a few times, and in this particular make the secondary terminals are so located that it is often impossible to get at them after the switchboard has been put in operation. It would be very much appreciated by those who do the testing, and the trade in general, if the manufacturers of current transformers would equip them with a small knife or plug switch for short-circuiting them, as there is hardly a switchboard in operation that the meters do not have to be tested, etc., at some time. All of the switchboards being erected by our company are provided with testing plugs, which, when supplied with the board when new, add very little to the initial cost, which is very easily saved in the time saved to make the connections to test, over the old method. Our company is also equipping all of its power boards with test plugs that were not so equipped originally. The cost of doing this will very quickly be saved in the time saved making the connections and test, and, aside from this, the safety and convenience is very much increased.

The following points should be taken into consideration when deciding to purchase a graphic wattmeter.

1st.—The size of the contracted load and the possibility of a quick increase.

2nd.—The kind of load, whether steady or intermittent.

3rd.—The power factor of the load.

4th.—The length of the contract peak, and its relation to the actual peak. This is in order to determine the correct chart speed.

5th.—It is desired to know the maximum fluctuations of load or the average?

Records

A system of records, either cards or loose leaf system, should be kept of all the work done on the instruments. This will prove invaluable, for a reference as to what repairs have been done, when tested, cost, etc.

In conclusion, would say that from this company's experience, we have not found the best any too good, as there is not yet a perfect graphic on the market. There is room for improvement in some detail or other.

One fact that is very noticeable is the lack of information regarding this class of switchboard indicating instruments as regards repairs and recalibration. With the exception of the manufacturers' bulletins there is practically nothing to be had. A good book on this kind of work would be very much appreciated by meter men especially, and the profession in general.

This article should not be taken as covering all the points and details of graphic meters, but more as a review of the experience and methods followed by the company with which the writer is connected.

Electric Vehicles an Ideal Load

The Electric as a Revenue Producer Coast Cities Waging Vigorous Campaign

By Mr. C. Rummel

It is the general policy of our Company to leave the selling of appliances and current-consuming devices as much as possible to local dealers and agencies. This policy is based on the idea that our business is primarily that of a central station and that we should enter into the actual sale of current-consuming devices only when the local dealers and agents fail to push the sale of any particular branch as vigorously as the conditions warrant.

In the field of electrical vehicles the company found that there were a number of agencies within our territory, the same firms offering both gasoline and electric vehicles. These firms sold quite a few pleasure cars of the electric type but apparently made very little effort to introduce electric vehicles of the commercial type. It was found that when these dealers, being representatives of both electric and gasoline cars, came to a probable customer, the "prospect" generally knew considerable about gasoline cars but very little about electrics. The agent would tell him that he represented both electric and gasoline cars and would put forward the advantages of the type which the "prospect" preferred. This method of doing business was rather a detriment to the introduction of electric vehicles within our territory. To me it seems rather a mistake on the part of the manufacturers of electric vehicles to act through these combination agencies. The agent is, of course, after the dollars and cents and will naturally interest himself chiefly in the article which he can sell in the easiest way and to the greatest number. I have been told by a factory representative that the manufacturers do not care very much in the case of truck sales, their object being to have agencies sell pleasure cars, and that the field for electric vehicles of this type is so limited that it is impossible for one firm to handle the exclusive agency. The manufacturer noted has doubtless come to this conclusion after a thorough trial and we must take his statement as warranted.

As far as Vancouver is concerned, our company found that the practice of selling through combination agents did not result satisfactorily to our interests in connection with the sale of electric cars of the commercial type.

As a result of the above condition the company this year decided to take out an agency, enter the selling field and

*Presented before the C.E.A. Convention.

make a genuine effort to introduce electric commercial cars within its territory.

The first attempt to sell electric cars in Vancouver was made some seven years ago when a five-ton Studebaker truck was purchased by a local firm. There was at that time no proper electric garage or adequate arrangement for charging batteries of electric trucks, nor was the proper usage of the truck understood. Hence the car suffered considerably because of lack of facilities and ignorance as to the proper method of caring for it, this being especially noticeable on the point of overloading. However, in spite of these handicaps, this five-ton truck is in use to-day and doing good work.

In connection with its own work, our company purchased three electric trucks last fall, these being the only sales of electric trucks made at that time by local agents. These vehicles were used as a meter wagon, an arc lamp wagon and a line wagon, and did satisfactory work through a severe winter during which there was a heavy snow fall such as had not previously prevailed in this country for fifteen years.

On the basis of this good showing made by the few electric trucks in Vancouver, the company felt that vigorous efforts should be made to introduce this type of vehicle, although still preferring to leave the matter in the hands of the agents providing the business was properly pushed and adequate garages and facilities for caring for the vehicles would be provided. Upon canvassing the agents it was found that they preferred to have nothing to do with the garaging of trucks but preferred to confine their business in the electric line to pleasure vehicles only. The company then decided to take up the agency for commercial cars as previously noted.

At the very outset the company engaged an electric vehicle expert of eleven years' practical experience, both in selling and garaging. This man was given the advantage of extensive advertising in the daily press, thus thoroughly acquainting merchants with the advantages of electric trucks as well as the entrance of the company into the business. The salesman began his campaign among the wholesale men on February 15th, and has since been conducting an active canvass by personal visitation, follow-up letters, pages in the monthly motor magazines, etc. One very effective method followed was to offer the service of one of the company's trucks to reliable "prospects" for an ordinary day's delivery of the firm. Such an illustration proved conclusively the value of the truck to the merchant's business.

Since our salesman took hold of the work, sales of electric trucks have been made as follows: A two-ton truck to a wholesale fruit merchant, a two-ton truck to a wholesale hardware firm, and a one-ton truck for an hotel bus.

During the period the company has also found use for two two-ton trucks which have replaced a gasoline truck and a horse-drawn wagon and a business electric for the light and power department. The two-ton truck for the fruit merchant was placed on the streets last week and has so far given perfect satisfaction. The company's new trucks are also working satisfactorily and the hotel bus will be placed in operation about June 1st.

In addition to the company's orders, there have been sold to Vancouver firms through outside agents a two-ton truck of the electric type to a milling firm and a 750 lb. delivery rig to a local fish concern.

Our electric vehicle representative reports that his "prospects" are many, and every merchant to whom he has explained the electric trucks, even milkmen who have a house to house delivery, are interested.

In carrying out its business as an agent for electric vehicles the company generally orders the chassis only from the factory, the bodies and tops being built in the city to suit the purchaser. This plan is necessary from the standpoint of economy owing to the duty which must be paid on our cars from the States. It is also found that each customer has his own ideas as to style, dimensions, etc., of the top and body, and, if this work is done locally, closer supervision can be given to each part by the purchaser and he is better satisfied with the result.

Early in the campaign for the introduction of electric trucks the company found that there was a necessity for a proper garage for this type of vehicle. To meet this condition and cover the care of the company's trucks as well as those of our customers who did not desire to install their own charging outfits, it was decided to arrange for a garage in the central part of the city. This is now being built, and will provide 110 x 94 feet of floor space and a charging outfit consisting of a motor generating set of 45 kw. capacity. In the garage will be located offices for the superintendent and mechanic, battery room, store room for spare parts, tires, etc.

Before plans were finally made for the company's garage a meeting of all the dealers in the city interested in the sale of electric trucks was held. At this conference the electric vehicle question was discussed in all its phases, various types of batteries, their behaviour, their troubles and other points of interest being thoroughly considered, the meeting thus being most helpful to all in attendance.

At this meeting the charges which the company proposed to make for caring for electric vehicles of the commercial type at its garage was outlined and an agreement reached with the dealers on this point. These charges, which cover all types of battery, were as follows:—

Capacity of Truck	Garage Charges Per Month
750 lbs.	$45.00
1000 "	45.00
2000 "	55.00
4000 "	60.00
7000 "	65.00
10000 "	70.00

These garage charges cover the supply of current necessary for the operation of the vehicle, charging of the batteries, storage of the vehicle, daily washing and oiling, and the making of minor adjustments. These garage rates being established, our electric vehicle representative was able to quote to his "prospects" with assurance just what the cost of their deliveries by electric truck would be, a most telling argument with the prospective purchaser.

It is not the intention of the company to care for pleasure vehicles in its garage, as this field of work is already receiving the attention of the regular garages. For the storage of a car of this type, current for and charging of batteries, daily washing and oiling, etc., a monthly charge of $30 is made and in some cases the garages deliver and call for the vehicles.

A report has been recently obtained from the provincial authorities covering the number of electric vehicles which are now in use in British Columbia. According to this statement there are 100 pleasure cars and 12 electric trucks now operating within the province.

The field covered by our company comprises as a territory in which electric trucks would be chiefly used, the cities of Vancouver and Victoria. The references made in the preceding paragraphs to our agency for commercial cars, the establishment of garage, etc., refer only to Vancouver, where the head office of the company is located. The notation with reference to electric vehicles, however, applies to the entire province, and a number of these vehicles are operated in and about Victoria. Last year a large milling firm bought a two-ton truck for its Victoria trade and after operating the vehicle for a year was so satisfied with the results that this spring the concern purchased a five-ton truck and a two-ton truck, the latter now being in operation in connection with the firm's business in Vancouver.

In both Vancouver and Victoria a number of the private

garages are equipped with charging outfits for electric vehicles and the company also plans to maintain charging equipment at central points within its territory.

The various reasons why central stations are or ought to be interested in electric vehicles have been talked and written about to such an extent that it would be wasting your time to repeat the many thrashed out and worn phrases. Every central station man knows that if he can conduct an electric garage where he can induce his merchants to come to with their wagons and cart away the juice, that this not only saves the cost of distribution lines but that he has here a load absolutely under his own control in the matter of delivery. The majority of the wagons are charged after 9 or 10 o'clock in the evening, and once in a while a wagon might need boosting during the noon hour. Every central station man I have met admits that where a good vehicle charging business is obtainable there is not a more ideal load from a central station point of view.

Since entering this field I have noticed that the vehicle manufacturers look for the assistance and co-operation of the central station, and I found on my recent trip down the coast that every central station manager is fully alive to the possibilities of this new current-using device. The rates made for current leave no room for competition for either horse or gasoline wagon in respect of cost of operation. If the manufacturer will now fulfil his part and bring the cost of the truck within reach of the average merchant and not only of a prosperous few, the co-operation so attained would be most effective and complete. Our Canadian prices are at present too high. The cost of a five-ton truck f.o.b. Vancouver is about $7,500, a first investment which is beyond the means of the average merchant. The "Ford" people here are selling a 750 lb. gasoline delivery rig for about $800. The electric 750 lb. delivery wagon laid down in this city costs in the neighborhood of $2,500. It must be admitted that in face of this tremendous difference in first cost it requires an excellent salesman to convince a "prospective customer," that in spite of this difference he is making a saving by buying an "Electric." Most of this saving the central station claims is due to the economic operation of the Eleceric, brought about by low rates of current offered by the central station. The next move should therefore be on the part of the manufacturers to produce a vehicle at reasonable cost to the Canadian merchant.

I trust these few remarks will bring out a lively discussion at your meeting, and that the above information will be of value to you in obtaining an idea as to the situation of British Columbia with reference to electric vehicles.

Hydro-Electric Regulations

The New Rules of the Hydro-Commission Compared with the National Code

By Mr. H. F. Strickland*

Most people in the electrical business are more or less familiar with the National Electric Code which has been the standard of electrical installation work both in Canada and the States for some years.

The National Code has been adopted by every municipality in Canada and the States as the basis of their regulations.

The Hydro-electric Power Commission, however, deemed it advisable to investigate the merits of every available practice here and in Europe, in order to satisfy themselves as to the very best rules and regulations obtainable.

In writing or adopting rules and regulations it is a very difficult task to frame them in such a way as to render them sufficiently flexible, and, at the same time practicable; especially is this the case with new regulations, as it is not desirable to introduce drastic changes which might inflict serious loss upon manufacturers and the dealers in electrical supplies.

The National Electric Code has, in conjunction with its Underwriters' Laboratories, kept in close touch with the manufacturers of electrical fittings and material, so that it has been a difficult matter for doubtful or unsatisfactory material to be marketed. The Underwriters' Laboratories in Chicago enjoy an enviable reputation in the United States for absolute fairness, and their approval of materials is accepted without question by all underwriting bodies as well as by all Municipal Electrical Inspection Departments in the States and Canada, and being personally acquainted not only with the personnel of the Laboratories but having thoroughly investigated and had dealings with them continuously for a period of over eight years, I have no hesitation in stating that their reputation is well founded.

The National Electric Code has furnished the bulk of the rules of the new Hydro Regulations now before us, because it has been found after careful consideration that the adoption of such of the Code rules as have been selected is in every way appropriate at the present time.

It will be noticed, however, that the arrangement of the Code is somewhat complicated, and embodies, in a general way, rules covering every conceivable form of wiring, inside and out. There are a lot of recommendations, many "shoulds," frequent repetitions, and an equal or even greater variety of cross references.

In editing the Hydro Regulations the rules have, as far as possible, been put under proper classifications, and very few repetitions or cross references occur.

The general rules as now in the Code are practically unaltered, so that the manufacturers and dealers in electrical supplies will not be adversely affected.

The Hydro Rules contain practically no "shoulds" but are positive in nearly every ruling, which if enforced as intended, should place the electrical inspection work of Ontario in the front row.

Nowhere on this continent is there a State inspection similar to that now proposed, although there are numerous civic inspection systems, many such in the United States and a considerable number in Canada, but in each case they are isolated, and there is more or less difference in the interpretation of the same rules; for instance, the inspection in the city of Winnipeg, which is carried out under the rules of the National Electrical Code, may differ considerably from that in the city of Halifax which has adopted the same rules. This diversity of interpretation makes it a very difficult matter where contractors are called upon to execute work in cities where they have not been accustomed to do business, as compliance with the rules in each separate Inspection Department is often affected by the personality of the Inspectors in such districts.

The Hydro-electric Power Commission's system of inspection promises without reservation to be the very best method which has been devised in any territory of similar magnitude. Under the Power Commission Act, every Municipality in this Province must provide a sufficient and proper number of inspectors to enforce the rules adopted, and, owing to the fact that all disputes as to interpretation must be referred to the Commission for final adjustment, there will be such uniformity as will be not only of advantage to the general public but will, undoubtedly be a great source of satisfaction to all those engaged in the electrical business.

The Hydro Rules and Regulations, as now before the public, have not been drafted with the idea of covering every

*Presented before the C. E. A. Convention.

conceivable form of construction, large and small, as has been attempted in the National Code.

It is hardly necessary to have a special set of rules governing the installation of such works as large central stations, sub-stations and similar undertakings which are invariably installed under the supervision of competent engineers. Such installations will be treated on their own merits. The set of rules now before us is drafted for the purpose of covering all such general inside wiring as will be met with in every-day practice and which anyone is liable to be called upon to perform. While a large percentage of the rules is an adaptation of the National Electric Code, it has been a very difficult task to re-classify them, and in many cases, reword them in order to avoid the cross-reference and repetitions now so evident in that Code. In addition to this it has been found necessary to introduce a great many new rules and to enlarge many of the Code Rules to make them more comprehensive and complete. I will take a few concrete examples by way of illustration. In the first place, the new Regulations open up with some five pages of preface; this preface explains the nature of the legislation and the interpretation thereof in order to convey to the contractor and others interested such necessary information as will enable them to comprehend the scope of the rules in question and the interpretation which will be placed upon them. This preface takes the place of some short introductory matter now in the Code, which latter is after all but a suggestion. Turning to page five we find a section covering "Switchboards," which contains some five pages of comprehensive rules as against less than one page in the Code, and in addition to this it is necessary to refer to other places in the Code to obtain all the data which affect "Switchboards." On pages eleven and twelve are found rules on transformers, and it is hardly necessary to look elsewhere for rules on this subject, whereas, transformers are alluded to in the Code in some four or five different places. On page twenty-one almost every point in connection with cut-outs, switches and circuit-breakers is to be found under the heading of "Controlling and Protecting Apparatus." The same general classification will be found to occur throughout the book. On page forty-six we come to an entirely new section not found in the Code at all, known as "Services and Service Meters." containing much valuable information and rules covering almost all the most essential features in connection with such work.

As an illustration of the enlargement of some of the Code rules, I would point out that on page forty-eight, reading as follows: "For low potential systems the service wires may be brought into buildings through a single iron conduit, the conduit to be equipped with an approved service head." In the National Code this is all that is said about such work, whereas, by reference to Hydro Rules you will find that this rule is extended throughout the next four or five pages covering practically every detail in connection with such work.

Prominent among the new rules not found in the National Code are those necessary for the protection of life. From some of the finished rules bearing on this feature, I will cite the following: "Under 'Generators' and 'Motors' the grounding of frames is called for where the potential exceeds 300 volts." Similar new introductions are found under "Switchboards" and "Electric Cranes." Under "Installation Work" on page forty-five, such rules as "k" and "l" are intended to reduce danger, neither of which appear in the Code at all. In a word, in various places, rules have been introduced which are calculated to protect unskilled persons and those who are liable to inadvertently come in contact with live parts, from receiving injurious electric shocks. It is, of course, impossible to make any source of energy, attended with danger, absolutely foolproof without placing such restrictions around it that its use would be impracticable and onerous, and the best that can be accomplished is to so reduce such danger that it will be safe to use electricity in its various forms.

Up to the present time there has been no legislation of any kind in this Province bearing upon the introduction or use of electricity, with the result that anyone, skilled or unskilled, could install electrical apparatus in any way be pleased, and so long as the lights burned and the wheels turned, it was regarded by the consumer or purchaser as evidence of a satisfactory job.

It is true that the Fire Underwriters have, through their influence, been able to prevent a good deal of loss, chiefly from fire, but where they have no insurance at stake they are powerless to do anything. Municipalities throughout the Province have been, and are to-day, operating plants with old transformers, with ungrounded secondaries, and we all know that it has caused the loss of many valuable lives. The loss from fire from defective wiring has, undoubtedly, been a serious item, and I am firmly convinced that many of the serious fires throughout small towns of this Province have started from defective wiring. It is a common sight to see such wiring in large hotels and stores throughout this Province which is just inviting disaster. I have been in places where the electric current is never shut off from dusk until daylight, where large stores are left at night with lights burning and all wires alive. It is a common sight to see these wires protected (?) by fuses which would allow the wires themselves to melt before the fuses; to see open fuses in dangerous proximity to highly inflammable material, the bulbs of lamps lying on inflammable goods, draperies pinned to flexible cords in show windows, wires lying on gaspipes in the basements of stores and hotels, old frayed flexible cords hanging around in dangerous proximity to inflammable material and often not protected by fuses, circuits overloaded, five, six and even ten times above the proper limit; bare joints in wooden moulding, loose connections under switch terminals and a multitude of other kindred and dangerous defects.

To the uninitiated mind these defects do not convey any idea of serious consequence, but to those who understand, it is only necessary to mention them to show the need of proper control and supervision of electric wiring and the installation of apparatus.

We do not claim that our book of rules is a finality on this subject but we think that they are the best start which can be made, and they will be revised as circumstances warrant it, and I am sure that it is the Commission's desire and intention to keep thoroughly abreast of the times and keep this book of regulations well in touch with the best current practice, and not only to effect a great improvement in the conditions referred to but to secure the co-operation of all those who are called upon to execute electrical work.

In reading this paper it is not my wish to convey to anyone that the use of electricity is highly dangerous. We in the electrical profession know that electricity is conceded to be the safest illuminant and form of power known, and in concluding I would draw attention to this fact in order that the general public may know that while it is necessary to prescribe rules and regulations it is not intended to prejudice the lay mind against the use of electricity in any form. On the contrary, we all know that under a proper system of inspection and regulation it is the safest and most convenient agent for the purpose.

In conclusion, I would point out that I have endeavored to give an outline of the Hydro Rules in a short space and hope that they will be received favorably by those present who, I trust, will realize that it is a difficult matter to present a thorough and comprehensive digest of the entire situation in a few minutes. If, however, there are any points on which I have failed to touch, I shall be pleased to explain them to the best of my ability.

Central Station Advertising

The Various Methods Classified and their Relative Merits Discussed

By Mr. D. H. McDougall*

A central station company's business can be defined as selling profitably electric service.

Before selecting the best let us first endeavor to classify the various possible methods of advertising.

The methods or mediums of advertising may be divided roughly into two classes:

1. By direct contact with the public.
2. By printed advertisement.

In effective printed advertisements let us borrow two axioms:

1. The advertisement must be read.
2. The advertisement must be true.

In order to make an advertisement attractive enough to be read sometimes the second axiom is stretched nearly to the breaking point, but a company that is in a permanent business cannot afford to forget the saying of Abraham Lincoln, "You can't fool all the people all the time." When the public find that there is anything extravagant about a company's advertisements, they grow suspicious of the company itself, and consequently, the result is apt to be detrimental instead of successful or impressive.

The first division of advertising can be divided into:—

1. Delivering the goods.
2. Courtesy to the public at every point of contact.
3. Direct personal canvass.
4. Periodical visits to consumers to solicit criticism and forestall complaints.
5. Prompt and cheerful attention to complaints of consumers by means of an efficient emergency force.

In considering the question of advertising and the best methods of securing results, we would undoubtedly select the methods classified as Direct.

The printed advertisements of all classes, as we said above, must be true to be successful, and how can they be fruitful if the goods are not delivered, or only partially delivered?

No matter what the printed ads. can say, how long would the consumer remain (if he has the option of changing his service) if every time he has occasion to come in contact with the company, or with an employee of the company, he is met with brusqueness and antagonized?

Every employee of the company is a medium for advertising the company by his or her courtesy and efficiency. Possibly next to the actual delivery of the goods, courtesy is the best method of advertising the company's business.

The direct personal canvass by agents, salesmen or other canvassers should be of next importance in considering methods of advertising. This, of course, depends to a large extent on the efficieny of the company's representative. It also depends, like the printed advertisement, on the truth of his statements.

If a salesman secures a contract on the promise that a service will be installed in 24 hours and by reason of his having overlooked the fact that no standpipe has been erected and the consequent delay is one week before the service is installed, the advertisement secured by the agent is liable to be detrimental, and in the same way if the agent promises service in 24 hours and by reason of the inefficiency of the service order department, or the service department, or any other department of the company, the installation is delayed, the advertisement is a poor one. A poor ad. is worse than none at all.

In the same way every employee, whether telephone operator, complaint clerk, demonstrator, billing clerk, office boy or delivery driver, can advertise the company by accuracy, courtesy and efficiency, probably with better results to the company than any printed advertisement.

The complaint department is one of the most important branches of the business, as it is through this department that the customer probably comes most in contact with the company, and by the treatment and manner in which he is met he forms a large part of his opinion of the company's efficiency. A company should select with greatest care the representatives to handle its complaints, and should look to these representatives for an advertisement of the business.

Having said so much for the means of advertisement classified as Direct, let us turn to the second division, namely, Printed Advertisements.

There are several methods of printed advertising which might be classified in the following order of importance:—

1. Direct advertising, by which is meant a company magazine (or house organ) published monthly, circulars, letters, pamphlets, etc., sent direct to ascertained prospects or others it is desired to interest.
2. Daily newspaper advertisements.
3. Bill board, street car and electric sign advertising.
4. Weekly papers or magazine advertising.
5. Theatre programmes, charity and entertainment programmes, etc.

We have selected as of first importance in the printed advertisements what is known as direct advertising, that is, by means of the house organ, circulars, circular letters, pamphlets, etc., mailed direct to ascertained prospects and others it is desired to interest, because His Majesty's mails are pretty reliable and the company can be reasonable sure the printed matter will arrive at its destination.

We have quoted the axiom in referring to printed matter, that it must be read to be effective, and, of course, this is true of circulars as it is of newspaper advertisements.

By careful composition and selected and tastefully set up matter, a magazine, circular or pamphlet can be made so attractive that it will not only be read, but, if sent out regularly, be looked for. The amount of ignorance, or, shall we say, the lack of knowledge of things electrical displayed by the public is astonishing to the initiated, and the field for the dissemination of primary or rudimentary electrical information is very favorable to the electrical companies. If this field, ready for the sowing, is carefully cultivated and the planting is done with selected seed of a simple and understandable nature, the resulting harvest should be an ample reward for the workers.

Somebody said: "Wisdom is humble because she knows no more," so great care must be taken in all advertising not to show an overbearing or exalted attitude toward those less informed.

By means of attractive literature that will be read, more good for the company can be done than by any other means of printed advertising, always provided the articles are true.

The daily newspaper advertisement can be made next effective if the reading public are at all sympathetic or interested in the company, but as a means of converting an antagonistic public, it is of doubtful effect, unless the papers themselves are fair or, at least, unbiased toward the company.

A small antagonistic news item in the same edition as the company's advertisement will, to a large extent, neutralize the effectiveness of the carefully prepared ad.

The next method of importance in our opinion is that of bill board, street car and electric sign advertising. Possibly the electric sign should be placed first of these three, as an electric company should endeavor to practise what it preaches. On the other hand, the electric signs, especially the flashing enormities that are seen in New York and other large

*Presented before the C. E. A. Convention.

cities, are better adapted to advertise manufacturer's articles than a central station service. We believe that dignity is lacking in many of the modern signs, and the flashing qualities are a detriment and more or less objectionable from our standpoint where service and steadiness without flamboyant and spread eagle boastfulness are to be accentuated.

Bill boards properly illuminated should be a good medium of advertisment, provided they are made attractive and pleasing to the eye and made up so that he who rides may read.

Street car advertising is more or less effective, but is more adapted for appliance advertising than for any other branch of our business.

The fourth division, weekly papers and magazines, are much in the same category with the daily newspapers, except that they are liable to be read on Sundays in the homes and less hurriedly than the dailies, but, if the editorial departments are antagonistic, their efficiency is largely weakened.

The other methods of printed advertising, namely, theatre programmes, baseball score cards, charity entertainment programme ads., etc., give probably less results than those previously mentioned, but, if the material is carefully compiled can be made of some benefit to the company.

On the whole the best method in our opinion of advertising the company's business is service, by which we mean delivering the goods in every branch of the organization with efficiency and courtesy.

Public Utility Service

The Value of "Service"—Prompt, Courteous and Continuous—Outlined

By Mr. Stephen L. Coles*

Service is a fundamental necessity in the upbuilding of any public utility.

In none of the several lines of public utility endeavor is service of more importance than in the ramified business carried on by the central electric station.

For no other one business comes so near to the people as does that of the central station. It supplies light, heat and power to the home, the store, the office, the hospital, the theatre, the factory and frequently for transportation.

The successful sales manager of a central station has a better grasp of the social, political and business conditions in his community than any one else. By virtue of his position he gets a bird's eye view of his city as a whole, and of necessity accumulates a wealth of intimate detail through his personal, direct contact with all sorts of people.

If a magazine editor, or the managing editor of a daily newspaper, had the same opportunity of gauging his public, he would forthwith produce a magazine or a newspaper that would almost eliminate competition.

The success of a central station, not only as a public utility, but as a business proposition carried on for the profit of its stockholders, is in direct ratio with the service it gives.

I do not hesitate to say that the rate of dividend is to a very great extent dependent upon the degree of service.

Naturally, perfect service is 100 per cent. efficient and we place it as the idol of our hopes on the same pedestal as the operating engineer places his ideal load curve—the straight line.

It is only within the past ten years, say, that the real importance of service has received the full attention of central station executives. The growth of appreciation of its value has been so rapid, however, that to-day we hear the officials of public utility companies strenuously urging the abandonment of the term "central station" for the newer and more appealing title "service company."

Rapid as has been the change of heart on the part of central station managers, even more sudden and surprising has been the education of the public as to just what "service" should mean to them. At the present moment, the public is quite sufficiently informed to demand and insist upon service. There is but one alternative for the central station. It must give service. Failure to do so will at once impair the good will of the company, indirectly lessen the value of the existing plant, growth and progress will halt in their tracks, and an unseen, but none the less powerful opposition to the company will be engendered. Carried to the limits, such a state of affairs points but one way—to the chasm under the warning signboard "competition."

Any and every central station should adopt a "service" policy for purely selfish business reasons. Even a brief analysis of the question will demonstrate that the interests of the company and those of the public are identical. Therefore the central station that serves its public well, serves its stockholders and itself equally well. In these days progress in any business is founded on service.

The most valuable asset a central station can possess is the good will of the public it serves. And this good will many be increased and made to grow to a wonderful extent by constant improvement in every detail of service.

Nothing that enters into service or has a bearing upon it is trivial. The central station manager who has his mind and his eye on the little details of his business is the one who is constantly approaching the ideal of service. Nothing is unimportant that affects in the slightest degree his relations with the public.

Having established the vital importance of this matter of service, let us attempt to answer the natural inquiry: "What is service?"

One dictionary definition is: "An agency for the accomsome general and recurrent demand." The lexicographer who coined this definition easily might have taken the central electric station as a concrete example for the purpose.

Another definition is: "The act or means of supplying some general demand."

It follows, therefore, that **every point of contact between the company and a customer is an opportunity for service.** The manner in which any such opportunity is grasped is an exact demonstration of the company's ability to give service.

*Presented before the C. E. A. Convention.

New Books

Electric Wiring & Lighting—By Chas. E. Knox, E.E., and Geo. E. Shadd, E.E.; the American School of Correspondence. Chicago, publishers. Price $1. The material in this volume is specially adapted for purposes of self construction and home study. The utmost care has been taken to make the treatment of each subject appeal not only to the technically trained expert but also to the beginner and the self-taught practical man who wishes to keep abreast of modern progress. The language is simple and clear, heavy technical terms and difficult formulae having been avoided, though without sacrificing any of the requirements of practical instruction. The book is divided into two parts. Part I. dealing with electric wiring and Part II. with electric lighting. For purposes of ready reference and timely information it is believed this handbook will be found to meet the general requirements. It is very well illustrated and printed and bound to sell at a higher price.

The Electric Reduction Company, Limited, of Buckingham, Quebec, are putting in an hydraulic development to generate 3200 horse-power. Possibly half of this amount will be used to generate alternating current electric energy. Mr. W. A. Williams is managing director of the company.

Constant Voltage Transmission Lines

A Discussion of Better Regulation of High Voltage Transmission Lines by Control at the Receiving End as Well as at the Generating End

By Mr. H. B. Dwight

For deciding upon the method of operation of a transmission system, two distinct alternatives are presented, one of which has been brought forward but recently. In the older method, which is the one in common use, the voltage of the system is controlled entirely from the generators. The disadvantage is the large variation in voltage, which is indeed the factor limiting the carrying capacity of the system. In the newer method, there is no voltage variation at all, this result being obtained by controlling the voltage from both the generating end and the receiving end. The newer method also increases several fold the carrying capacity of a transmission line. This new constant-voltage method has been used successfully in commercial operation though as yet only on small systems. It offers large advantages both in better service and in lower cost over the usual varying-voltage method.

It is proposed to make a comparison in the following paragraphs between the two methods, dealing especially with the reduction in cost made possible for large power systems, the reliability of the new method, and the ways in which the new method of operation may influence the design of transmission systems.

The method in common use with transmission lines needs but little description as it consists merely of controlling the voltage on the line by adjusting the voltage of the generators supplying the power. Since at no-load the two ends of the line are at approximately the same voltage, while under load there is considerable drop at the receiver end, a variation in voltage is unavoidable as the load increases or decreases. This variation may take place at the generator end or the receiver end, as desired, but in either case it put a limit on the amount of power which the line can transmit. A system which delivers electric power to a customer at a voltage varying 10 or 15 per cent. throughout the day is not considered to be giving good service, as the operation of lights and motors is seriously interfered with. Therefore when the load on a transmission system becomes so large as to produce too great a variation in voltage for good service, it has been the customary practice to build additional transmission lines, or to adopt a higher line voltage. It is at this stage that constant-voltage transmission appears most attractive, as it provides greatly increased carrying capacity without any alterations in the transmission line itself.

The constant-voltage method of control is radically different from the usual method. Instead of controlling the voltage from one end only, special machinery consisting generally of synchronous motors or synchronous condensers is installed at the receiver end, and the voltage is controlled at that end also by adjusting the power factor. Enough synchronous motors are installed to keep the voltage at a steady value at both the receiver end and at the generator end.

The way in which the synchronous motors operate to hold the voltage constant is very similar to the way in which they are frequently used to improve the power factor of a load. It is well known that a large part of the voltage drop in a transmission line is due to the line reactance. The reactance drop is greatest when the load has a low power factor, and it is, in fact, directly proportional to the lagging reactive component of the load. The drop is therefore changed into a rise in voltage if the reactive component is leading instead of lagging, and this may be sufficient to overcome the drop due to resistance. This is expressed in symbols as follows.

Let R be the resistance of the line and X the reactance. Let P be the in-phase component of current and Q, the lagging reactive component. Then the drop in voltage is approximately

$$PR + QX$$

or, more exactly,

$$PR + QX + \frac{(PX - QR)^2}{2(E + PR + QX)}$$

where E is the voltage at the receiver.

If now Q is made negative, that is, if it is a leading current, QX opposes the drop PR and tends to neutralize it. The quantity Q can be controlled by adjusting the field current of the synchronous motors, since with a strong field the motors will operate with a leading current. It is therefore possible to control the voltage at the receiver end by adjusting the field current of the synchronous motors. This adjustment must be under the control of the transmission line operators in order to have the correct effect on the line voltage.

In water-power plants the voltage and also the frequency are subject to sudden changes due to variations in load which are too rapid for the water wheel governors to compensate for immediately. In such cases a large flywheel effect on the system tends to minimize this trouble. Synchronous motors add directly to the flywheel effect and are found very useful in this way.

The advantages obtained from the use of synchronous motors by maintaining constant voltage at both the generator and receiver ends of the line and by adding to the flywheel effect, have been sufficient to warrant their installation on several short transmission systems. In such cases the improvement in the service given to customers at all parts of the system justified the additional expense. But when it is

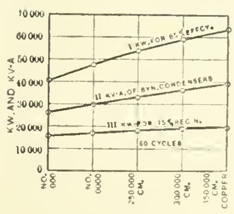


Fig. 1

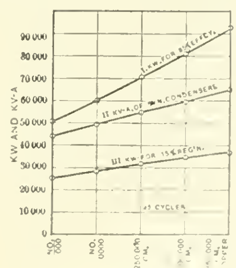


Fig. 2

stated that the synchronous motors must be equal to one half or two-thirds of the generator capacity the cost will at first sight seem prohibitive for most cases. In consideration of this, the additional fact must be taken into account that the newer method not only improves the service, but very greatly increases the carrying capacity of the line. Since with a line of about 100 miles in length the cost of the generators is comparatively small compared with the cost of the line, the installation of synchronous motors will actually

* Presented before the A. I. E. E.

save money in large systems, by saving extra line construction.

The limit of carrying capacity is ordinarily set by the maximum variation in voltage allowed for good service, that is, by the regulation of the line. But if there is no voltage variation at all, another limit must be looked for, and this will be found in the greatest energy loss which can be allowed for the transmission. Power for supplying line losses costs very little in most systems, so that an efficiency of 85 per cent. is generally consistent with good economy. The curves for Figs. 1 and 2 for constant-voltage lines have been plotted for this value of efficiency. A glance at these curves shows that the carrying capacity of a 25-cycle line can be doubled by adopting the constant-voltage method, and the capacity of a 60-cycle line can be multiplied by two or three.

It is shown in the diagram, Fig. 5, that there is a maximum amount of power for a constant-voltage line, which cannot be exceeded under any conditions without raising the voltage, no matter how low the efficiency is allowed to become, nor how much synchronous machinery is installed. This has been pointed out by Mr. Philip,* and a diagram given for the case where the receiver voltage is equal to the generator voltage. The practical limit to the carrying capacity of a line is smaller than the above maximum, due in most cases to the energy loss becoming excessive and to the rapid increase in the amount of synchronous condensers required. The present paper therefore uses as a practical limit a moderate percentage of loss, such as corresponds to about 85 per cent. efficiency.

The saving in cost effected by the constant-voltage system increases very rapidly as the number of miles of line becomes greater. The curves of Fig. 3 show that for 60 cycles, the cost of a constant-voltage line with the necessary synchronous motors represents a saving when the length is over 70 miles. For 25 cycles, Fig. 4, the saving over the varying-voltage method is not obtained until the length is 120 miles or more. As noted elsewhere, no allowance has been made for cost of land, owing to the extreme variableness of this item. If this were included, the constant-voltage curves would show more favorably. On the other hand, no allowance has been made for the cost of power for line losses, which are greater for the constant-voltage lines used in calculating the curves than for the corresponding varying-voltage lines.

The costs as plotted are merely approximate, and are not intended to give an actual estimate of what a transmission line would cost. The curves are presented rather to show the effect, on the cost, of changing certain factors such as size of conductors, length of line, and method of control.

The comparisons in Figs. 3 and 4 are not quite complete, owing to another saving in cost which is possible when designing a line for constant-voltage work. This saving is made by using large conductors. The cost curves show that with an existing line of considerable length it pays to install synchronous motors if enough power is to be transmitted to utilize the line to its full capacity of the new basis. As may be noted from the first two figures, the increase in carrying capacity, and therefore the saving in cost per kilowatt, is greatest when large conductors are used. In ordinary transmission there is practically no advantage in using a larger conductor than about No. 4/0 copper for 60 cycles. Reducing the resistance to a value less than one-third of the reactance does not materially improve the regulation, which is determined under these conditions almost entirely by the reactance. But with constant-voltage operation, a large proportion of reactance to resistance within a certain limit is no longer a hindrance, and so large conductors can be used to good advantage. This increases the carrying capacity of the line at small extra cost.

*R. A. Philip, *Economic Limitations to Aggregation of Power Systems.* Trans. A. I. E. E., 1911, p. 612.

It may be mentioned as a minor consideration that a line with large conductors will have a comparatively small amount of corona loss, and so it may be operated at a higher voltage than where smaller conductors are used.

It was pointed out that high reactance is a detriment to a line operating with varying voltage but is not such a great disadvantage when the constant-voltage method is used. For instance, Figs. 1 and 2 show that a smaller proportion of synchronous motors is needed with a 60-cycle line than with a 25-cycle line. This is due to the higher reactance of the 60-cycle line. Now the reactance used in estimating the curves has been merely the reactance of the line. The reactance of the entire circuit includes that of the generators, step-up transformers, protective reactance coils, and step-down transformers, as well as the line reactance. Of late years it has been customary in large systems to make all these reactances as large as possible for protective reasons, in spite of the fact that they tend to make the regulation poor, and so limit the power which can be transmitted. High reactances give protection by reducing short-circuit currents, which are tremendous in large power stations and are very destructive both in their heating effects and in the mechanical distortions which they produce in the apparatus. High reactance in the reactance coils placed between the line and the station apparatus gives very effective protection against abnormal voltages due to lightning, and to surges caused by switching. It is evident that with constant-voltage transmission it will be economical to increase all these reactances much beyond the values in use at present and better protection will thus be obtained. It may therefore be stated that the possibility of using high reactance in all the various kinds of apparatus connected with the system, is one of the most important points in favor of constant-voltage transmission.

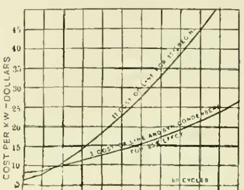


Fig. 3

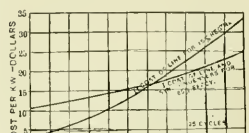


Fig. 4

It may safely be stated that the reason why the frequency of 25 cycles was adopted to any extent in this country was because its low reactance made it more economical for transmission. This is shown by the curves of Figs. 3 and 4. The same figures show that with constant voltage, the frequency of 60 cycles becomes as economical at 25 cycles. With the exception of railway work, the frequency of 60 cycles is preferable for most important applications of electric power, especially the supply of power to large cities. The cost of generators, transformers, and motors is generally less at 60 cycles, and the operation of most lighting devices, especially tungsten lamps and arcs, is much more satisfactory at the higher frequency. Any method, therefore, which tends to make 60-cycle transmission more economical than 25-cycle, should be welcomed, as it will assist in standardizing the electric machinery of the country at the single frequency of 60 cycles.

The most advantageous application of constant-voltage transmission is probably not in transmission lines with a single generating station, but rather in large transmission networks connecting all the hydro-electric plants and the cities within a radius of several hundred miles. The generators placed at various points of the network themselves partly take

the place of the synchronous motors for maintaining constant voltage, and thus the total capacity of synchronous motors required is somewhat less. Duplicate lines for use as reserves in case of breakdown are not required as much in networks as in straight transmission projects, since power can generally be supplied to any point from more than one direction. Thus a small number of heavy lines can be used in networks, and constant-voltage operation is especially applicable to these. All the advantages of low cost, good service, and good protection which have been described for constant-voltage transmission lines, are to be obtained with a large transmission network operated with steady voltage at both generating and receiving stations.

Very large transmission networks have already grown up, and are steadily increasing in extent. The engineering advantages of combining small power systems into one large network are due to the combination of differing load curves, water storages, reserves in case of breakdown, and even differences in standard time, etc. These have been discussed so thoroughly that they need only be mentioned here. The principles of constant-voltage transmission can greatly increase the economy and range of operation of large transmission networks. It does not seem unreasonable in view of the already rapid growth of many of these systems, to state the possibility of a single high tension network for the supply of power over the entire country.

When larger transmission networks are advocated it might be objected that the limit has been already reached of

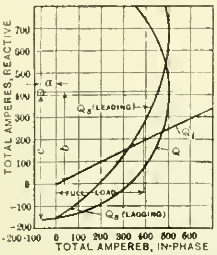


Fig. 5

the number of generating stations which can be connected to one network, owing to the danger from such large amounts of generator capacity when a short circuit occurs. But a network which is operated at constant voltage contains an unusually large proportion of reactance, both in the line and in the station apparatus. Thus when a short circuit occurs the voltage drop toward the short circuit is very rapid. Power is delivered to it practically only from the near-by generating stations of the network.

For example, if a short circuit occurs 100 miles from a station and the voltage is sustained at 100,000 volts, 60 cycles, at the generating station, a current corresponding to only about 100,000 kv.a. will be delivered from the station. This is not such an excessive amount as to interfere with the safe opening of the circuit breakers. The presence of protective reactances very greatly reduces the short-circuit current, so that it may be said that a station 100 miles away from a short circuit cannot send a dangerous amount of current to the short circuit.

The greatest danger, then, comes from a short circuit in the immediate neighborhood of the largest generating station, and in that case the short circuit current is supplied almost entirely by the nearest station. The largest circuit breakers will therefore not need to be designed with regard to the capacity of the entire network, but only of the stations in which they are located. Circuit breakers are at present in successful operation in connection with as large generating plants as are likely to be constructed and so the problem of handling short circuits will probably not impose a limitation upon the size of transmission networks.

The two systems of varying-voltage control and constant-voltage have been described as being quite distinct. There is really, however, a middle ground between them. For instance, consider a line operated with 20 per cent. voltage variation at the generators between no-load and full load, and with a steady voltage at the receiver. Now by installing a small number of synchronous motors at the receiver, the generators may be operated with only 10 per cent. variation, the synchronous motors being used to hold the receiver voltage constant. Twice the number of synchronous motors would allow constant-voltage operation at both generators and receivers. It is possible, therefore, to install a small amount of machinery and obtain a proportionate improvement in closer regulation or in increased carrying capacity of the line.

The above fact is of great importance in relation to the commercial application of the principles of constant voltage operation, since a new method appears much more attractive to a transmission company if the change can be made gradually without interrupting service, and if the results of a small alteration can be observed before investing any large amount of capital.

Many power companies offer special terms to induce their customers to install synchronous motors and thus raise the power factor of the load. This can scarcely be called a step in the direction of using the principles of constant-voltage transmission, since the field current of the synchronous motors is not adjusted with a view toward regulating the line voltage. The advantages of a high power factor of load are very small indeed compared with the large advantages to be obtained from adjustable power factor.

It must not be supposed that the voltage at all points of a constant-voltage transmission line or network has exactly the same value. At all points where there are generators or synchronous motors whose field current can be adjusted, the voltage will be held steady. For the best economy, however, the generator voltage should be held at a higher value than the receiver voltage. Thus the voltage at the generating stations may be held constant at 110,000 volts, while the voltage at the receiver stations may be held steady at 90,000 volts. This involves running the synchronous motors with a weak field and a lagging power factor at no-load, and there is a limit in doing this when the motors are carrying a mechanical load, due to the danger of the motors dropping out of step. However, the capacity of synchronous motors required is so large that most of them would have to run unloaded as synchronous condensers, since mechanical loads could be found for only a few of them. The curves which have been given assume that the synchronous condensers will operate at their full rating of lagging current at no-load, as well as with leading current at full load.

Synchronous condensers can be designed so as to remain in step, when running unloaded at 100 per cent. power factor, as tenaciously as a fully-loaded induction motor. If necessary, the starting torque could be sacrificed for the sake of the synchronizing power, and the condensers could be started by small starting-motors, though it would be preferable to have them self-starting. At times of very light load on the line, such condensers can operate safely with weak fields and lagging power factor. Thus, in spite of the fact that loaded synchronous motors and synchronous converters are commonly regarded, and rightly so, as a very unstable element in transmission line operation, it may be stated that the addition of properly designed unloaded synchronous condensers to a transmission system, as described in this paper, does not decrease the reliability of the system. In fact, the extra reactance which would be used, as described above, renders the line more reliable instead of less so. It may be mentioned that probably more time would be taken in getting load on a line, after a temporary shut-down, where synchronous con-

densers are installed, but this is not a serious disadvantage if the system is more safe and dependable.

The charging current of the line due to the condenser effect is the same under all conditions of load, and does not affect the amount of machinery necessary for the adjustment of the line voltage as described in this paper. The effect of the charging current is to raise the voltage at the receiver, by a constant amount. The operation of a long constant-voltage line is made more satisfactory by the charging current, but the charging current cannot be considered a help when the line is operated with varying voltage.

It has been found in commercial practice with short lines that constant voltage transmission is worth while merely on account of the improvement in service. In the following paragraphs, estimated costs are given for comparatively long lines, so as to show, even more definitely than by the curves already discussed, that where a line is long, or land is high in value, it pays to adopt constant-voltage transmission, even without considering the improvement in service.

Summary

Constant voltage transmission requires adjustable power factor.

Advantages

1. Better service—no variation in voltage.

COMPARISON OF THE TWO SYSTEMS FOR A 200-MILE TRANSMISSION PROJECT

	The usual varying-voltage method	Constant-voltage method
Distance	200 miles	200 miles
Power delivered	33,000 kw.	33,000 kw.
Power factor of load	90 per cent	90 per cent
Frequency	60 cycles	60 cycles
Number of three-phase circuits	3	1
Conductors, copper cable	No. 0000	350,000 cir. mil.
Maximum voltage on line	116,000	116,000
Voltage at load end	100,000	85,000
Reactive drop in transformers at each end	4 per cent	5 per cent
Reactive drop in protective coils at each end	4 per cent	7 per cent
Synchronous condensers at load end	None	18,000 kv-a.
Synchronous condensers required at no-load		16,500 kv-a.
Voltage variation	21 per cent	None
Voltage variation due to line alone	14 per cent	None
Efficiency of transmission	91 per cent	87 per cent
Power factor at generators	99 per cent lagging	89 per cent lagging
Approximate Costs.		
Towers, ground cables, insulators and erection	$1,140,000	$440,000
Copper cables, at 18 cents lb	1,080,000	600,000
Synchronous motors and space in substations, at $10 00 per kv-a		180,000
Cost of line, exclusive of land	$2,220,000	$1,220,000
Saving		1,000,000

N.B. The charging current of the line was allowed for in calculating the above results.

COMPARISON FOR A 100-MILE TRANSMISSION SYSTEM

	Varying-voltage method	Constant-voltage method
Distance	100 miles	100 miles
Power delivered	54,000 kw.	54,000 kw.
Power factor of load	80 per cent	80 per cent
Frequency	60 cycles	60 cycles
Number of three-phase circuits	3	1
Conductors, copper cable	250,000 cir. mil.	400,000 cir. mil.
Maximum voltage on line	113,000	113,000
Voltage at load end	100,000	90,000
Reactive drop in transformers at each end		5 per cent
Reactive drop in protective coils at each end		5 per cent.
Synchronous condensers at load end	None	42,700 kv-a.
Synchronous condensers required at no load		21,500 kv-a.
Regulation due to line alone	15 per cent	None
Efficiency of transmission	95 per cent	91 per cent
Power factor at generators	87 per cent lagging	89 per cent lagging
Approximate costs.		
Towers, ground cables, insulators and erection	$618,000	$227,000
Copper cables at 18 cents per lb	.612,000	343,000
Synchronous condensers and space in sub-stations at $10.00 per kv-a		427,000
Cost, exclusive of land	$1,260,000	$997,000
Saving		263,000

N.B.: The charging current of the line was allowed for in calculating the above results.

2. Better protection, due to high reactances.

3. Tendency to use the frequency of 60 cycles.

4. Increased carrying capacity of line. The limit is changed from maximum voltage variation to maximum energy loss. This allows more power to be transmitted or the distance to be increased, without the voltage being raised.

5. Lower total cost for long lines. The saving cost is greatest for long lines or large networks, large quantities of power, large conductors, and for the frequency of 60 cycles.

6. The method is easy to apply to existing lines. The change can be gradual, and no change is necessary in line construction.

Disadvantages

1. Cost and attendance of additional rotating machinery.

2. Higher total cost for short lines.

3. In order to obtain the greatest economy from constant-voltage operation, the losses must be increased, and the number of separate lines, which are useful as reserves, must be reduced.

4. Tendency of synchronous machinery to drop out of step, and delay in putting load on the line again after shutdown.

The author also appends some further data concerning formulae for the voltage drop from generator to receiver.

The Canadian National Exhibition

The committee which have the Canadian National Exhibition for 1913 in charge have just issued Bulletin No. 1, in which they outline in part the special features of this autumn's exhibition, which, in many of its details is calculated to excel anything that has been shown in previous years.

Arts exhibit—This year the galleries will be divided into four sections, British, German, United States and Canadian, and the entire exhibit promises to be a distinct advance over all previous collections that have featured the Canadian National.

Water carnival—Aquatic sports will be a feature at this year's exhibition and will include motor boat races, war canoe races, swimming races, aeroplaning, hydroplaning, etc.

New midway.—A brand new midway, with brand new shows is advertised for the present year. It is said that the objectionable features have been eliminated, and that this part of the exhibition will be carried out according to a much higher standard of amusement.

Music—This will be furnished by the band of the Irish Guards which created such a favorable impression in 1905, and by Patrick Conway's band which is along the line of the famous Gilmore band. These will each give two concerts daily.

Live stock—The new live stock department will this year give splendid accommodation for the fine animals for which the big fair is noted, and will, at the same time, add a finish to the artistic appearance of the grounds.

Scenic production—This year's evening pyrotechnic display will be supplemented by one of the most elaborate scenic productions ever shown on the continent, in the reproduction of that splendid historical spectacle, "The Burning of Rome." The evening performance will require some 800 performers.

The record attendance at the Canadian National Exhibition at present stands at 962,000, a matter of 38,000 below the million mark. This year it is hoped to reach at least the million mark, and it is quite likely this number will be exceeded.

The ratepayers of Gananoque passed, by a big majority, the by-law to give the Electric Light Company a ten-year contract and a thirty-year franchise. They also carried the by-law re Gananoque and Arnprior Railway.

ELECTRIC RAILWAYS

The Pittsburgh Autobus Line

The Pittsburgh Auto Transit Company was organized for the purpose of supplementing existing street railway lines and providing a frequent, fast and comfortable means of automobile transportation through a high-class residential district. Eight large single-deck omnibuses with Brill-built bodies, mounted on White chassis, were placed in the new service, which will probably extend into other parts of Pittsburgh. The machines run from the City Hall, past the Union Station, along the Grand Boulevard section to Highland Park. The route is about six miles long. Near Highland Park, the east end of the route, the east and west-bound lines separate, passing through a well-developed business section.

The new omnibuses are noteworthy in several respects: they have an unusually large seating capacity for a single-deck vehicle—34 persons—which is equal to that of the standard double-deck machines used in London, England; they have longer and wider bodies than usual and are operated on the one-man prepayment principle. The latter point is especially interesting because it demonstrates the extent to which one man can control both car and passengers in a heavy-traffic zone, with a seating capacity greater than that of a single-truck electric car, and operating methods requiring not only greater attention but more skill and a higher degree of mentality.

Type of Autobus Operating in Pittsburgh—Seating Capacity 34.

A single doorway is used for both entrance and exit. The chauffer's seat is directly opposite, giving him a clear view ahead and to both sides. The lever by which he controls the double-leaf folding door is in convenient reach of his left hand. A wood partition, with a pipe stanchion extending to the roof, is placed next to the doorway to prevent interference between passengers in the longitudinal seat on that side and those boarding or alighting. A stationary cross seat is backed against that occupied by the chauffer; the remaining seats are also of the stationary transverse type. An emergency exit is placed in the rear end, and when closed is covered by a portable seat. The windows have an interesting feature in the stationary upper sashes set in a single frame that extends from end to end; the reinforcement so given the body structure is obvious. The lower sashes are made to raise their full height.

Following are the principal dimensions:

Length of body	23 ft. 0½ in.
Centers of side posts	2 ft 4½ in.
Width over sills	7 ft. 7 in.
Width over posts (rear)	8 ft. 0 in.
Width over posts (front)	7 ft. 0 in.
Extreme width	8 ft. 2¼ in.
From pavement to side sills	2 ft. 9 in.
From side sills over roof	7 ft. 5 in.
From floor to center of headlining	6 ft. 10½ in.
Street to first step	11 in.
First to second step	11 in.
Second step to floor	11 in.
Seating capacity	34
Type of chassis	White 5 ton
Wheel base	19 ft. 1 in.
Diameter of wheels; front 36 in.; rear	40 in
Weight of chassis	8,500 lb.
Weight of body	5,100 lb.
Total weight	13,600 lb.

New Cars for Regina

The corporation of the city of Regina recently received a shipment of eight double truck cars for their municipal street railway system from the Preston Car & Coach Company. This makes a total rolling stock of twenty-eight cars made up of eighteen double trucks and ten single trucks.

The specifications of the new double truck cars are as follows:—The length of the car body 28 ft.; front vestibule, outside, 5 ft.; rear vestibule, outside, 7 ft.; projection of bunters 6 ft.; length of car over bunters 41 ft.; width of car over side sheath 7 ft. 8 in.; height of car from bottom of sills 8 ft. 9 in.; width of front vestibule door 30 in.; width of rear vestibule door 48 in.

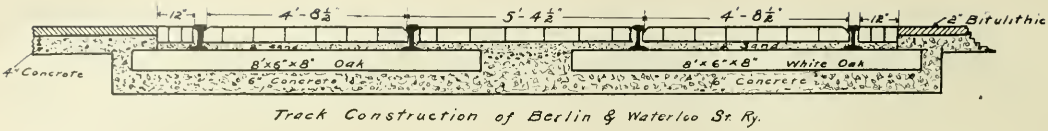
The motors are Canadian Westinghouse type No. 101B, and Canadian General Electric Quadruple 80. The air brakes are Peacock hand type and Canadian Westinghouse straight air. Cars are p.a.y.e. semi-convertible; trucks are Brill 27 Gl. double; wheels are Midvale all-steel 33 in. diameter; axles are Midvale hot rolled steel; Providence fenders; Root scrapers; Crouse-Hinds imperial junior arc headlights.

Mr. H. Doughty is superintendent of the Regina municipal railway system.

Toronto's Traffic Rules

Acting under the Public Health [illegible] last session of the local legislature, Dr. Hastings, Toronto's Medical Health Officer, has framed a number of rules to regulate street car and other traffic in the city of Toronto. The rules are as follows:—

From and after the approval of these regulations, all companies or corporations operating street passenger cars or vehicles constructed and used for the purpose of carrying passengers, whether propelled by horse, electricity, or cable power, are prohibited from hauling, carrying, or conveying in any car at one time a greater number of passengers than is equal to 1 2-5 times the proper seating capacity thereof, with the addition of five passengers on the rear platforms of each car, and said railway companies or corporations are



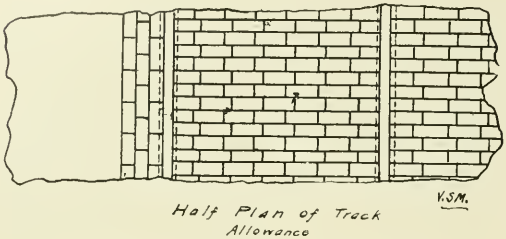


Fig. 1—Berlin and Waterloo track construction

further prohibited from carrying any passengers between the seats of open summer cars.

None of the said street cars or vehicles shall be furnished with cushions on the seats or back made of any material that cannot be readily cleansed and disinfected, and all cars shall be so constructed as to provide for and secure efficient ventilation and heating at all times, to the satisfaction of the Medical Officer of Health.

A Fahrenheit thermometer shall be hung in the centre of each and every car.

Each and every street car used for the transportation of passengers shall, on the days on which it is used for such purpose, be carefully and thoroughly washed and cleansed on the inside, and all cushions and upholstering throughout cleansed by means of a vacuum cleaner.

All straps or hangers on any of the aforesaid cars shall be composed of or covered with celluloid, or a similar non-absorbable material, and must be regularly cleaned, as ordered by the Medical Officer of Health.

B. & W. Track Construction

The Berlin & Waterloo Street Railway System, operating in and between these two towns, have in the past used a 6 in. T rail, Loraine Steel Company, Section 72, No. 331. These rails are received in 62-foot lengths and jointed by special fish plates as shown in cross-section in Fig. 2 herewith. The plan of track construction is illustrated in Fig. 1. White oak ties rest on a 6 in. concrete bed. The gauge is 4 ft. 8½ in. with 5 ft. 4½ in. devil-strip and 12 in. paving on each side of outer rails. Paving blocks rest on a 2 in. sand cushion. Surface plan of track allowance is also shown in Fig. 1. Mr. V. S. McIntyre is superintendent of the street railway department which is under the control of the Berlin Light Commissioners.

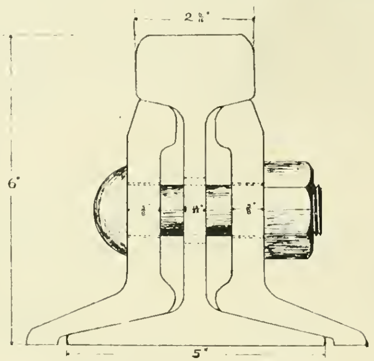


Fig. 2—B. & W. track construction

M. & S. C. Developments

The Montreal and Southern Counties Railway have now a regular service from Montreal to Chambly and Richelieu, this being the latest extension of the company's system. The cars are of a new type, at least so far as this company is concerned, constructed by the Ottawa Car Company. Each car has a seating capacity for 56 persons, three to four cars making up the usual train. Four 50 h.p. motors are installed on each car and the whole train is controlled by the motorman in the leading car by means of the multiple control system. The cars are equipped with automatic air brakes with emergency attachments, and also with automatic and foot sanders for forcing sand upon the rails. Three electric locomotives were recently ordered by the company from the Ottawa Car Company, each capable of hauling eighteen loaded freight cars. The entire electrical equipment for the cars, locomotives, station, sub-station, etc., has been supplied by the Canadian Westinghouse Company. The Chambly sub-station contains three 185 kw. 25,000/2,300 volt single-phase transformers which operate a 600 h.p. 3-phase slip-ring type motor-generator set.

3 car train, Montreal to Chambly

Will Electrify Steam Line

The Pacific Great Eastern Railway Company which at present is constructing a line from Fort George to North Vancouver, is prepared to electrify that portion of its route extending from Horseshoe Bay on Howe Sound through West Vancouver to North Vancouver, a distance of about 10 miles, providing these municipalities will grant the company a 60-foot right-of-way through this territory free.

It is proposed to operate an hourly service from 6 a.m. until midnight with additional trains on holidays. The company intends to proceed with the construction of this portion of its line immediately the request for a free right-of-way is complied with.

A number of property holders along the route are willing to accept the proposition, and at the present time it would seem that there are good prospects of the matter reaching a satisfactory settlement.

Illumination

Illumination of Toronto Hydro-electric Store

A great deal of attention has been attracted by the recent installation of lighting in the Toronto Hydro-electric office on Yonge street. There is probably no office in Canada that entertains as many visitors or has as many people passing it as this office and every effort is made by Mr. Charles Dudley, who has charge of the sales and display room, to bring the attention of the public to electric devices of merit for all purposes. To make this room the best lighted room in Canada was one of his ambitions, and to accomplish this there was recently installed twenty-six Holophane Realites—twenty in the office proper and three in each of the two windows. The effect of this installation is wonderful. The office is not only as light as mid-day on a bright June day, but it has a quality of light that equals it. It is a magnificent demonstration of what can be accomplished by

Interior Toronto Hydro Electric Store

scientific study of the lighting needs. The Holophane Realite is a Toronto product and one to be proud of. It is meeting with an unusual demand for high class store and large room lighting.

Beautiful Glassware Display

During the Canadian Electrical Association Convention many of the visitors, as well as the many passers-by, were attracted by the beautiful display of lighting glassware in the Toronto Hydro-electric System window on Yonge street. This display was loaned to the Hydro for the occasion by The Holophane Company, Limited, Toronto, and consisted not only of their Holophane reflectors, Holophane Realites, Holophant D'Olier steel and enamel reflectors, but also bowls of many shapes and pleasing designs for semi-indirect lighting. These were shown in the Calla and Veluria glasses which are distinctively different from the ordinary white glasses that have become so common. Attention was called to the various types of glass by neat signs, one of which advised the many lookers that there is a Holophane globe or

Glassware Display in T. H. E. Windows

reflector for every need. Quite a number of the large units shown were under light, and a flasher arrangement under two of them gave a constant and beautiful change of colored lights. Another sign called attention to the fact that Holophane glass is now a Toronto product and that the Holophane Realite was endorsed by the Hydro system. As a whole the display was a great credit and received most favorable comment.

Illuminating Engineering Society

It has been definitely decided to make the Hotel Schenley the headquarters of the Illuminating Engineering Society Convention which will be held in Pittsburgh, September 22-26. The programme as outlined at the present time covers an exceedingly interesting set of papers on the various subjects pertaining to illumination. In addition to the technical sessions of the Society, the Local Committee has arranged for a series of entertainment features in which the ladies are included. These features cover golf, tennis, base ball games, automobile rides, theatre and card parties, and conclude with a banquet at Hotel Schenley at which some innovations are promised. Inspection trips have been arranged to several industrial plants including the Westinghouse Electric & Manufacturing Company, Macbeth Evans Glass Company and the Carnegie Steel Company; also a luncheon at the H. J. Heinze Company, the home of the 57 varieties, for the ladies.

The papers as scheduled at this time include, among a number of other subjects, the Quartz Light, Fontune, and Neon Tube; Church, Factory, Store, Hospital and Street Car Lighting, The Present Commercial Development in sev-

eral forms of Lighting, Errors in Photometric Measurement, and the History of Artificial Lighting. In addition to these, a number of others on equally interesting subjects will be presented by authors well-known to the engineering profession in illuminating as well as other fields. The development of the new flame carbon arc lamp will also be discussed by representatives of the manufacturing concerns. An interesting feature in connection with the technical sessions will be the holding of symposiums on the various general subjects to be led by those particularly well posted on the different subjects. These meetings will afford an opportunity for free and open discussion that it probably would not be possible to obtain in a more formal meeting.

The A-B Tungsten Arc

The two illustrations herewith represent the most recent product of the Adams Bagnall Electric Company. It is a unit specially adapted to large store lighting and has also

recently been adopted by the C. P. Railway Company for round-house illumination. To all appearances it is also well suited for street lighting purposes where first cost is a prime consideration. These units are equipped with G-65 ABolite

reflector and the focusing type globe. It will be seen from the figures that the lamp units are easy of access for replacing or cleaning. Lamp sizes of 500 or 1000 watts are generally used.

The Walkerton Electric Light and Power Co.

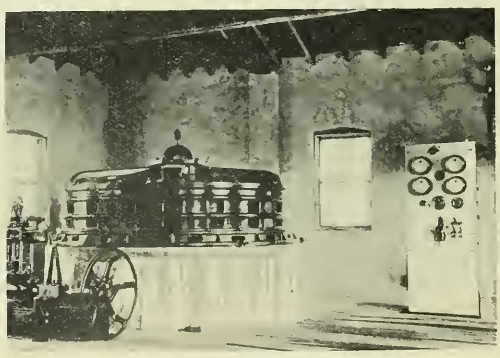
New Hydro-Electric Plant on the Saugeen River, Two Miles Above the Town

The Walkerton Electric Light & Power Company of Walkerton, Ont., have just placed their new hydro-electric power station in operation. The new plant is situated about

New power house—Walkerton

2 miles above the town of Walkerton on the Saugeen River, where a substantial concrete dam has been built, giving a normal head of 9 ft. The power house has been built about 800 yards below the dam by which arrangement an additional head of approximately 3 ft. is obtained, so that a normal working head of 12 ft. has been secured.

The plant at present consists of a 150 kw. 2300 volt, 3-phase, 60-cycle generator operating at 120 r.p.m. The gen-



Generator, switchboard, etc.—Walkerton

erator is a Swedish General Electric vertical type machine, with ball thrust bearing carrying the weight of the rotor and water wheel runner. The water wheel, which is direct connected, is William Kennedy manufacture. The exciter is a separate unit of sufficient capacity for a duplicate alternator, for which provision has been made in the power house.

The Power Company are at present installing additional 125 street lamps. An order has also just been placed for a second machine of 75 kw. capacity which will be installed in the old power station and will be used for light load service as it is the intention to give a 24-hour supply. All the electrical equipment has been supplied and the new generator will also be furnished through Messrs. Kilmer, Pullen & Burnham, of Toronto.

The Dealer and Contractor

The Architect vs. The Contractor

There are no two classes of workers more intimately associated than the architect of a building and the contractors for the various items of construction work. This is equally applicable to the Electrical Contractor who frequently hinders and whose work is often delayed by that lack of cooperation and understanding which works for efficiency and promptness in building construction. A number of points in this connection are nicely brought out by an architect, Mr. Louis R. Christie, in a recent issue of The National Electrical Contractor. Mr. Christie writes as follows:—

Frequently there is that different point of view between architect and contractor which puts a variable interpretation upon the work of the latter, his manners and his methods of doing business. There should be no difference of opinion—but there often is. Architects as well as contractors should be broadminded, wide gauge fellows who know what is what, and can render decision unbiased and uninfluenced by personal interests, but unfortunately like other professions, this one contains some cranks.

Nevertheless, you will find the majority of architects doing business on sound business principles. "Whatever is right is right" will be found the motto of most offices and contractors may be sure of a square deal as a rule.

When there is friction between architect and contractor you will find (according to the architect) that the trouble lies largely with the contractor; in the eyes of the contractor the fault lies with the architect. Many times the contractor is solely to blame. To appreciate this let us consider just what the architect stands for—what his duties are and what an owner should expect from him.

In the first place an architect is hired by the owner to get a good job. This is the paramount consideration—that the work be well done. An owner can forgive his architect if the design of his building isn't quite up to the highest standard of art, but he will never cease to regret having employed him if mortar falls out from between the stones in the foundation, or if the plaster cracks, or insulation of electric wires dries up and disintegrates and there is continual trouble from short circuits.

Now in order to get this first-class work in all branches of the building trades, every contractor knows that vigilance is required. No matter how square a contractor may be, he is at the mercy of his men. When the contractor's back is turned, careless workmen can slip in any amount of slip-shod work, almost certain to cause trouble later on, and yet the bad work may not be discernible from the good and neither architect nor contractor is aware of it until trouble ensues.

You must not expect the architect to put his finger on every piece of faulty construction in the building. His duty in supervising is done when by ordinary inspection he is able to pass upon the quality of work that appears to prevail. Neither should you expect him to stand on the job and show the men how to do their wiring. That is a job for the boss, and I must confess it is a job that some bosses neglect, especially those who leave everything to their foreman and do not check the work personally.

Contractors should realise also, that the quality of work which they and their employees do on the job is not everything. The way they handle their work is quite as important, for like every other business man, contractors are selling not merely executed work, but service. It makes a lot of difference to the architect whether the contractor handles his work promptly—efficiently with least annoyance or not. To do good work is not enough if the entire running of a job makes trouble.

Three architects at lunch the other day were discussing the relative merits of certain electricians. Said one, "Collins is a tip-top fellow, as honest as the day is long. He has every intention of following specifications and his men are thoroughly reliable, yet do you know, I believe I'll have to stop his figuring in my office." "Why so," said the second. "He's so careless," replied the other. "Now here's a sample—I go on the job and discover that four or five wall outlets in a room which is to be panelled are set so low that when the carpenters come along to put in their panels the outlets will have to be moved. Collins very good naturedly moves them after considerable delay. Then I find the wrong kind of switches being put in, and an outlet or two left out in one room and a couple more located in the wrong place in another, notwithstanding that the plans and specifications are correct and specific."

Good Natured but Incompetent

"Now," he went on, "Collins doesn't do these things intentionally. The whole trouble is caused by his not watching the work himself, to see that it is right. He seems to think that it is the place of an architect to see that the wiring is correct; he thinks he can fall back on me—that I will keep his work straightened out and he need not watch it particularly himself."

It is surprising to find this attitude among contractors—men who have every intention of being square in all particulars, but careless put it up to the architect to run the job. There is no vocation where efficiency is more necessary than in the electrical trade. Considerable ingenuity is required in locating outlets so that they will not interfere with trim or doors. Plenty of patience is needed to see that conduits are extended with minimum of cutting. The trouble with electrical work is that faults do not show up until the carpenters come to trim the building—sometimes not until the building is completed. First thing you know a piece of trim goes slap over an outlet—or when it is too late, it is found that an outlet does not come in the center of a panel or in a bedroom outlets in a pair are placed to close to permit of the dresser being located between. Then there is a lot of fussing and changing.

But to return to our three architects and their conversation (which I can assure you is not imaginary, because I was there and heard it); "You will find Henderson a dandy electrician," said the third architect, "and I advise you to

have him do some of your work. Here's the way he handles mine; to begin with, when I ask him to figure he always gets in his bid promptly; it is typewritten and clear so you don't have to take a day off to ferret out what he is driving at. Next, if he is awarded the contract, he sees that a set of plans and specifications is given him and these are studied until he knows the job from beginning to end."

"His next move," the architect went on, warming up, "is to find out exactly when I want him to begin work, and he is careful to make an appointment with me in advance at the building to check over every outlet shown on the plan to see if any changes are to be made."

"Now the next thing on the programme," said the architect enthusiastically, "is entirely original with this man; I never saw it done before though I wonder why other contractors do not adopt the same custom. After approving the location of every outlet, Henderson has his foreman mark their position on the building with blue chalk, then I chase the owner around to approve them and the job is ready for his man to start work. You have no idea what a help this chalking up of outlets is to owners who do not sense their location until they see them marked in this manner. Often it saves many annoying changes later."

They Noted His Address

The other two architects entered in their note-books the name and address of the electrician who had made such a hit by his efficiency, and I have no doubt by this time he is securing work from them simply as a result of that conversation.

"When you get right down to it," said another architect to me recently, "if contractors would only realize what a boon it is to a busy architect to have his jobs go right along in a systematic way, they would be more careful in supervising of their own work. I'm thinking of a firm of plumbers we have been obliged to cut off from our contractors' list simply because every job they undertook put an extra strain on my office. This firm is honest enough, but both partners are so careless that someone must check them up to make sure they don't build a water closet in the parlor. They are perfectly willing to make everything right, but it takes a lot of supervision from us to head off their careless mistakes."

I went to a building recently to start the electrical work and there wasn't a sign of either plans or specifications on the job. The foreman asked me to locate the outlets for him. Where are your plans? I asked. He had none. How do you expect me to remember where outlets are and locate them without plans? Well he didn't know, but his boss had told him that Christie could show him where the outlets were to be. This is a thumb-hand way of doing business, and bound to annoy any architect. There is often so much trouble over the little details of electrical work that by the time the architect gets his building finished and the owner has moved in, the architect is about ready to give up his profession and go into some other business. Much of the trouble may be an architect's own fault by not keeping in close touch with the job—or sometimes, a job is let at too low a figure to some cheap-skate electrician, after which, of course, there is bound to be trouble—but you will frequently find that annoyance is caused by the busy electrician who, loaded up with contracts, expects too much of the architect.

Control of Stationary Suction Cleaners

The diagrams herewith indicate the wiring arrangements for an alternating current under motor operating a suction cleaner or other similar equipment under automatic control. The diagrams cover single, two and three phase and the motor may be controlled from any number of remote points of which four are shown in the diagrams. Fig. 1 is designed primarily for a three-phase current but may be operated single-phase by omitting the central wire. Fig. 2 can be operated two-phase either three or four wire as indicated. The type of remote control illustrated in these draw-

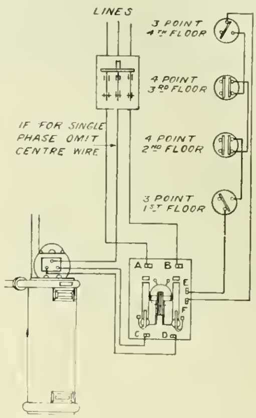


Fig. 1.

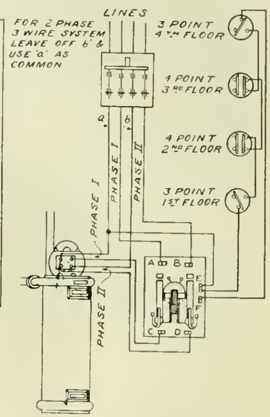
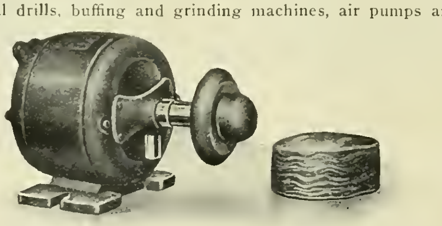


Fig 2.

ings is such that the motor may be started or stopped from any one of a number of points, but if a switch at any one point has been turned into the "on" position so that the motor is running, the turning of the switch at any other point will stop the motor. In our next issue we shall illustrate a simple arrangement by which the opening or closing of a switch at any point does not interfere in any way with the condition which may have been produced by any other switch, i.e., if the motor is already operating as the result of one switch being turned in the "on" position the turning "on" or "off" of another switch does not affect the motor.

Small Motor Applications

Almost all machines operated by hand or foot power require less than one-quarter h.p. Such machines are far too numerous and diversified in form to enumerate here, but a few of the more important are: sewing machines, washing machines, bench drills, marking machines, house pumps, dental drills, buffing and grinding machines, air pumps and

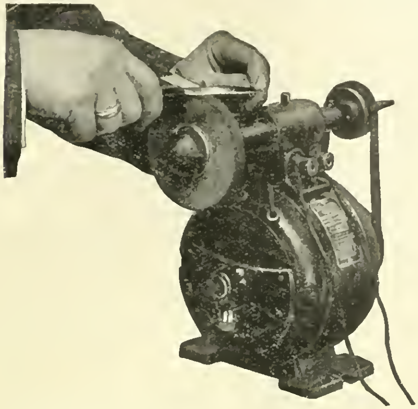


Domestic Buffing and Grinding Motors—1/30 H.P.

blowers, folding and wrapping machines, cigar and cigarette rolling machines, cleaners, planing machines; all classes of small industrial machines.

To operate such machines, the Canadian General Electric Company have developed a complete line of fractional horse power motors for all commercial circuits, comprising

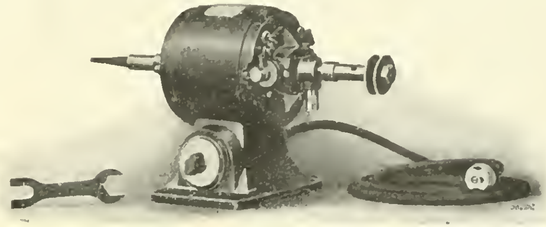
sizes varying from 1/50 to 1/4 h.p. inclusive. The frames of these motors are made of drawn steel, in place of a cast framework. This method gives an exceptionally neat and compact construction, and at the same time, by its reduced thickness and weight, serves to decrease the temperature of interior parts. The stator punchings are assembled in the drawn shell between two sets of spacing rings. The open edge of the shell is then rolled over the punching under heavy pressure. This cylindrical frame may be used with any special method of support, or may be attached to the standard flat base casting, or to a sliding base. The bronze bearing linings of all these motors are lubricated by underfeed oil cups, or oil ring bearings, depending on the size and duty to be performed.



Commercial Buffing and Grinding Motors—1/8 H.P.

All single phase motors have a simple and reliable starting switch, assembled within the motor frame. This switch automatically opens the starting phase of the field winding when the motor approaches full speed. Single phase motors can be supplied with clutch or clutchless armatures. The nature of the load must be carefully considered when deciding whether a clutch or clutchless motor should be applied. Machines requiring automatic and periodical reversal with considerable inertia to overcome during reversal, should as a rule be driven by clutchless motors. Loads having high inertia at starting, but not calling for reversal after being put in operation, are usually well operated by clutch armature motors. Both the foregoing requirements demand motors with high starting torque. Blowers, fans, etc., can frequently be operated with satisfaction by using clutchless motors having light load starting characteristics. Since no hard and fast rules can be laid down to govern the application of these small motors, each case must be studied very carefully, to determine properly the choice of motor. For special duty, motors can be made up with totally enclosing covers. Standard motors will operate satisfactorily on circuits where the variation of either frequency or voltage does not exceed 5 per cent. For a.c. motors, the full load speed is approximately 5 per cent. less than the synchronous speed, and for d.c. motors, the actual operating speed may be 5 per cent. above or below the rated speed. All C. G. E. drawn shell motors are rated by the actual h.p. they develop at the pulley, and not on the input expressed as horse power. The latter method is very misleading, since a motor rated, for example, at 1/8, and having efficiency of 50 per cent., would actually develop only 1/16 break horse power. The starting currents of the single phase motors with clutches are approximately three times normal full load values, while the starting currents of motors without clutches (i.e., with solid armatures) are approximately five to six times normal full load rating.

The following average values, taken from a series of tests will serve to illustrate the salient characteristics of these motors:



Jewelers' and Dentists' Buffing and Grinding Outfits 1/10 H.P.

Tests at 60 cycles, 110 Volts, single phase

H. P.	Running Free Amps.	Running Free Watts	Running Free Speed	At Full Load Amps.	At Full Load Watts	At Full Load Speed
1/30	0.67	25	1790	0.75	55	1730
1/15	1.10	35	1790	1.40	100	1700
1/10	1.70	50	1790	2.00	140	1700
1/8	1.95	50	1790	2.20	165	1720
1/6	2.00	50	1790	2.60	190	1750
1/4	2.86	70	1790	3.75	275	1740

Tests at 110 Volts, Direct Current 1700 (Rated Speed) Shunt or Compound Wound

H. P.	Running Free Amps.	Running Free Watts	Running Free Speed	At Full Load Amps	At Full Load Watts	At Full Load Speed
1/30	0.25	27.5	2000	0.45	49.5	1750
1/15	0.26	28.6	2120	0.78	86.0	1780
1/10	0.27	29.7	2100	1.25	137.5	1730
1/10	0.36	40.0	1850	1.20	132.0	1650
1/8	0.37	41.0	2070	1.38	152.0	1730
1/6	0.39	43.0	2100	1.88	206.0	1650
1/4	0.55	60.5	2080	2.45	269.5	1715

The Canadian General Electric Company at present list several hundred different motors between 1/50 and 1/4 h.p., for various circuits and classes of duty.

Boving & Company of Canada, Limited

The business of the Canadian Boving Company will in future be operated under the title of Boving & Company of Canada, Limited, so as to bring this branch into line with the branches of Boving & Company, Limited, London, operating in various other parts of the world. At the same time it is announced that owing to the great increase in the volume of the Canadian business and to their having purchased the works of the Madison Williams Manufacturing Company of Lindsay, Ont., the capital of the company has been increased to one million dollars and the scope of their manufactured articles has been somewhat enlarged.

This company are now in a position to turn out from their Canadian works the following machinery—Water turbines, centrifugal pumps, pulp and paper making machinery and saw mill machinery. Of these the centrifugal pumps have in the past been made in England, the water turbines, pulp and paper making machinery in Sweden and the saw mill machinery by the Madison Williams Company of Lindsay.

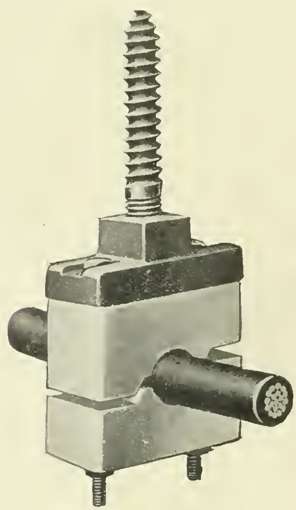
The Canadian Boving Company completed their first large installation in Canada in 1910 when they supplied water

turbines of some 8,000 h.p. capacity for the Calgary Power Company. Other orders up to that time and since that date include the city of Winnipeg seven units, totalling 29,900 h.p.; the Sydney Power Company, Trenton, eight units, totalling 10,800 h.p.; the Chicoutimi Pulp Company; the town of Farnham, P.Q.; the town of Welland; the St. Francis Hydraulic Company, D'Israeli, P.Q.; the Carillon Development & Construction Company; the city of Penticton; the Ocean Falls Pulp Company. The above orders were all for turbines. Centrifugal pump units have been supplied to the city of Toronto; the Nipissing Mining Company; Montreal Water & Power Company; the town of Welland; Delta municipality; the city of Moose Jaw; E. B. Eddy Company, Hull; city of Prince Albert; town of Preston.

The experience gained during the past three years by the Canadian Boving Company has enabled them to gauge the Canadian markets and familiarize themselves with the requirements of it. Working in close conjunction with the parent company, Boving & Company, Limited, London, Eng., it is certain they will be able to meet the needs of the Canadian market promptly and satisfactorily.

New Cable Hanger

A cable hanger to facilitate the hanging of feeders in mines, has recently been placed on the market by the Electric Service Supplies Company. These hangers are particularly designed for suspending feeder cables in mines, but are adaptable for use in various other locations. They are used for hanging cable of from ½ to 1 inch in diameter, inclusive, and permit the placing or removal of the cable after the



Cable Hanger for Mines.

hanger proper has been permanently installed. As shown in the illustration they consist of two split porcelain insulators, notched and fitted together to receive the cable and clamp it squarely. These porcelain insulators are bolted together—the bolts extending through the cast-iron head, which is specially designed to afford easy installation. The clamping surface of these insulators is ribbed to prevent any tendency the cable may have to slip through the clamp and damage the insulation.

These hangers are fitted with lag screws 3 inches long, for use in connection with wooden plugs. For timber work a special lag screw of the same length is furnished. They may also be supported by special expansion bolts. The hangers are 3¼ inches wide and 4½ inches high, exclusive of the lag screws or expansion bolts. All metal parts are heavily galvanized to effectually withstand the action of rust. Every part of this cable hanger is designed to meet the most excessive service, and to afford an easy means for hanging heavy cable.

Trade Publications

Annual Report—The twenty-seventh annual report of the Commissioners for the Queen Victoria Niagara Falls Park, covering the operations for the year 1912, is to hand.

Electrical Specialties—1913 catalogue issued by the Chelten Electric Company of Philadelphia, describing the principal house wiring specialties manufactured by this firm. This company make a specialty of push button switches and receptacles.

Fans—Ad book No. 30 issued by the Canadian Westinghouse Company, Hamilton, describing their fans and the multitudinous uses to which they may be put during the hot season. This company manufacture fans of all sizes and suitable for all operating conditions.

Turbines and Centrifugal Pumps—A comparison between low pressure water turbines and centrifugal pumps, and the inferences therefrom applied to the construction of irrigation and drainage installations, published by Escher Wyss & Company from their Montreal office.

Solderless Connectors—The 10th yearly catalogue issued by Dossert & Company, descriptive of Dossert Solderless Connectors for solid and stranded wires. In the preparation of this catalogue the different types of connector and the use to which each may be put are fully described. The catalogue is very completely illustrated.

C. G. E. Publications—Bulletin No. A4119 issued by the Power & Mining Department of the Canadian General Electric Company dealing with the application of electricity in the packing industry. Bulletin No. A4110, issued by the Supply Department, entitled Cloth Pinions; pamphlet No. 480B describing the C. G. E. flatiron; No. 482-B on Luminous Radiators; and No. 503 illustrating and explaining the construction of type "H" form "K" transformers.

Glover's Almanac—W. T. Glover & Company, Limited, of Trafford Park, Manchester, Eng., have just issued their 12th almanac, for the year beginning July 1st, 1913. The almanac, as heretofore, is compiled with the idea that much useful information is contained in the technical items chiefly dealt with, and which the busy engineer has not time to refer to in the ordinary way. This calendar contains a reference for each day which will be found both interesting and instructive in every instance.

Telephone Equipment—Pamphlets 41 and 42 issued by the Stromberg-Carlson Telephone Manufacturing Company describing central energy telephones and standard local battery telephones including wall and desk and combination types. No. 41 describes all the reliable standards and some new telephones in connection with which, during the past year, many improvements have been made in design and quality. No. 42 describes fully all the standard local battery equipment in which some important improvements in the No. 896 type compact wall telephone are noted.

The Oshkosh Manufacturing Company are distributing a little six-page booklet on pole line anchors. This booklet fully describes in detail the new Oshkosh Patent Anchor.

Current News and Notes

Amherst, N.S.

The contract for extension to the South Park street transformer station of the Maritime Coal, Railway & Power Company of Amherst, N.S., has been awarded to Messrs. Rhodes, Curry & Company.

Aurora, Ont.

By a vote of 420 to 19 the town of Aurora endorsed the agreement whereby the Toronto & York Radial Railway Company agree to supply power at $25.50 per h.p. year. This is a five-year contract renewable at the end of that period. The company delivers current at 4,200 volts for power and 2,300 for lighting purposes.

Ayr, Ont.

By-law will be voted on July 21st authorizing Council to get estimates from the Hydro-electric Power Commission of Ontario.

Bright, Ont.

By-law will be voted on July 21st authorizing Council to get estimates from the Hydro-electric Power Commission of Ontario.

Battleford, Sask.

The report that current will be supplied to this town by the North Battleford plant is not correct. Battleford has now in course of erection two 200 kv.a. Westinghouse generators to be driven by Mirrlees-Diesel engines. The possibility of interruptions during the change in equipment no doubt led to the report.

Carlyle, Sask.

Tenders are called to August 1st by the John Galt Engineering Company, Winnipeg, for power house and reservoir, pipes, pumping system, steam pump, two boilers and stack, vertical steam engine, generator, exciter and switchboard, poles, copper wire, meters, transformers, tungsten street lighting, etc.

Chignecto, N.S.

The contract for an extension to the electric power station of the Maritime Coal, Railway & Power Company, at Chignecto, N.S., has been awarded to Mr. J. N. Page, Amherst. Steam and electrical equipment will be required.

Drumbo, Ont.

By-law will be voted on July 21st authorizing Council to get estimates from the Hydro-electric Power Commission of Ontario.

Edmonton, Alta.

Contracts have been awarded to The Edmonton Construction Company, 623 2nd street, and to Hulbert & Wilson Company for extensions to the Edmonton municipal telephone system.

Estevan, Sask.

Tenders will be called shortly for the construction of a new municipal power house. Chipman & Power are engineers.

Fort Frances, Ont.

The private local telephone company, represented by Mr. P. T. Roberts, recently submitted an offer to sell their system to the town for $5,000. This offer has been accepted by the council and a by-law will likely be submitted to obtain the necessary authority.

Flett Springs, Sask.

The Flett Springs Telephone Company has awarded contracts to the Northern Electric & Manufacturing Company for apparatus for a new system.

Goderich, Ont.

The Town Coucil contemplates installing a lighting system for park and all bridges.

A fire alarm system to cost approximately $1,700 is contemplated.

Grenfell, Sask.

A by-law was voted on July 4th to raise $15,000 to erect an electric plant. The British Canadian Engineering & Supply Company will get the contract.

Grandmere, Que.

Work has been started on the Cofferdam and power house to be erected by the Laurentide Company, Limited, at Grandmere, Que.

Lindsay, Ont.

The Bell Telephone Company are at work installing their wires underground on Kent and William streets.

Montreal, Que.

The Canadian British Insulated Company, Montreal, have received an order from the Quebec Railway, Light, Heat & Power Company for 14 cables ranging from 600 volts to three-phase, 23,000 volts. The cables, which are to cross the St. Charles River, are of the paper-insulated, lead-covered, double steel wire armoured, submarine type.

The Montreal Tramways Company have commenced work on the new routes approved by the Council. Some of the small changes are now nearly finished, but it will be between two and three months betore fhe important routes are available owing to the impossibility of obtaining intersection work. The main object of the plans is to relieve the congestion at the rush hours.

The Cook Construction Company, Sudbury, Ont., have been awarded the contract for the enlargement of the Montreal aqueduct at $2,322,562. This will enable 10,000 horsepower to be generated, 4,000 of which will be utilized for a city lighting scheme.

Through the kindness of Mr. Brown, chief engineer on the C. N. R. Mount Royal tunnel, members of the Montreal Electrical Society recently visited the tunnel and inspected the construction operations. The party were met by Mr. Lancaster, the electrical engineer, and were taken through the section of the tunnel from the western portal to the Maplewood shaft. The company have installed electrical machinery for carrying on the work, including three transformers 11,000/2,200 volts; three 2,200 volt motors for driving air compressors, rated at 1,100 cubic feet of free air per minute; one 2,200 volt motor, direct connected to a fourth compressor, with a capacity of 2,200 feet of air per minute and one rotary converter, 2,200 volts a.c. to 250 v. d.c. for the trolley line.

The Canadian Westinghouse Company, Hamilton, Ont., have recently purchased three engines from the International Engineering Works, Limited, for direct-connection to alternating current generators for the Canadian Pacific Railway. The Canadian Explosives, Limited, Montreal, P.Q., are to install two 14 by 18 Robb Corliss engines direct-connected to 125 kv.a. electric generators.

It has been definitely decided by Stone & Company, Limited, Deptford, England, manufacturers of electrical specialties, including the Stone system of car lighting, to establish a factory in the province of Quebec. The location, however, has not yet been settled. At first the accumulators will be constructed here, and eventually the complete apparatus

will be manufactured in Canada. The company have had an agency in Montreal for four years, and have installed their system on the C. P. R., G. T. R., C. N. R. and other Canadian lines.

Mr. J. J. Creelman has been appointed lecturer in railway economics at McGill University. Mr. Creelman is well known in electrical circles, being a director of several Canadian electrical companies.

The City of Montreal have given permission to the Bell Telephone Company to open 46 street sections for the construction of underground conduits. This is subject to the deposit of a sum of money sufficient to cover restoring these streets to their original condition. The company have also to reserve a duct in each conduit for the wires of the police patrol and fire alarm systems, and in addition must remove the poles when the conduits are constructed, except those absolutely necessary for distribution purposes.

By the declaration of a quarterly dividend of 2½ per cent. the stock of the Montreal Tramways Company has been placed on a 10 per cent. basis.

New Toronto, Ont.

On July 16th the ratepayers of New Toronto will vote on the question of closing a contract for the supply of current for light and power with the Hydro-electric Power Commission of Ontario.

Ottawa, Ont.

Application has been made to the United States Government for authority to regulate the flow of waters at the American Sault. The application is made by the Lake Superior Power Company. This reopens once more the question of the division of our international waterways in connection with which our Government and the Conservation Commission have found it necessary to be continually on guard. The question of diversion in this case will doubtless be referred to the International Waterways Commission composed of Canadian and United States representatives.

The members of the Ontario Railway and Municipal Board, with counsel and engineers have been making a personal inspection of the situation at Chats Falls, a water power the value of which will have to be decided by this board.

Prince Albert, Sask.

Tenders have been called for the construction of a new telephone exchange for this city to replace the present one which has outgrown its usefulness. It is understood that the automatic system will be installed of a capacity sufficient to accommodate 2,500 subscribers at the present time, and with an ultimate capacity of 3,000 instruments.

Plattsville, Ont.

By-law will be voted on July 21st authorizing Council to get estimates from the Hydro-electric Power Commission of Ontario.

Regina, Sask.

By a recent act of the local legislature it is now possible for municipalities to pay for their rural telephone systems by the issue of debentures instead of by cash payments as formerly. It is said that since the passing of the act 110 applications for incorporation have been received by the Government.

Russell, Man.

Contract has been awarded to C. D. Sparrow for the erection of a power house to accommodate Ruston-Proctor-Westinghouse gas producer units.

Sydney, N.S.

The Cape Breton Electric Company will extend its line to New Waterford and Florence, but it has not yet been decided just what course the line will follow.

Toronto, Ont.

Following recent interruption in the supply service due to breaks in the power line it has been recommended that this city instal an auxiliary steam plant.

Vancouver, B.C.

It has been announced that the Canadian Pacific Railway Company will proceed at once with the electrification of that part of their line between Castlegar and Rossland, B.C. The contract for the necessary electrical equipment has been let to the Canadian General Electric Company. 2,400 volt, direct current equipments are under consideration.

Welland, Ont.

On July 1st the town of Welland inaugurated their local hydro-electric service. The streets are illuminated by the ornamental tungsten cluster type standards.

Woodville, Ont.

A by-law was submitted on July 15th, authorizing the sale of debentures to the amount of $4,000 to provide for an electric distributing plant.

Winnipeg, Man.

Contract has been awarded to the Fort Garry Construction Company for an extension to the municipal terminal station on Rachel street.

Contract has been awarded to Vickers, Limited, Montreal and Sheffield, England, for manufacture, delivery and erection of three 5,000 kv.a. generators and auxiliary parts.

Tenders are received by the Board of Control till August 1st, for a 1000 kw. motor-generator set with accessories complete for King street sub-station.

The municipality of Fort Garry is negotiating with The Winnipeg Electric Railway Company to extend their present Park line through that municipality.

Moonlight Schedule for August 1913

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
Aug 1	7 40	Aug 2	4 10	8 30
2	7 40	3	4 20	8 40
3	7 40	4	4 20	8 40
4	7 40	5	4 20	8 40
5	7 40	6	4 20	8 40
6	7 40	7	4 20	8 40
7	7 40	8	4 20	8 40
8	7 30	9	4 20	8 50
9	7 30	10	4 30	9 00
10	10 10	11	4 30	6 20
11	11 00	12	4 30	5 30
13	0 00	13	4 30	4 30
14	1 00	14	4 30	3 30
15	2 10	15	4 30	2 20
16	No Light	16	No Light	
17	No Light	17	No Light	
18	No Light	18	No Light	
19	7 20	19	9 30	2 10
20	7 20	20	9 50	2 30
21	7 20	21	10 10	2 50
22	7 20	22	10 40	3 20
23	7 20	23	11 00	3 40
24	7 10	24	11 40	4 30
25	7 10	26	0 20	5 10
26	7 10	27	1 20	6 10
27	7 10	28	2 30	7 20
28	7 10	29	3 50	8 40
29	7 10	30	4 10	9 30
30	7 10	31	4 40	9 30
31	7 00	Sep. 1	4 50	9 50

Total Hours 175 40

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Generation, Transmission and Application of Electricity

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Theft of Electric Current

There is an odd inconsistency streak in the make-up of many an otherwise honest man which will allow him, with a perfectly clear conscience, to cheat a large private corporation by misrepresentation or by theft, direct or indirect, or by any one of the many "inactive" methods that, in the nature of the public service business, always lie open to the individual who cares to take advantage of them. Perhaps the most common and the easiest of these is the non-payment of fares on a steam or electric railway, but petty theft of gas and electric energy is also common in many cities and towns. And this petty sneak thieving is often traceable to individuals who consider themselves thoroughly straightforward and honorable and are generally so considered by others. It is an inconsistency that is very difficult to understand and yet none the less an offense against all legal and moral laws quite as much as the theft of any other kind of personal property. The very fact of getting on a train or electric car is a recognition of an agreement entered into with the company, by which the individual carried obligates himself to pay to that company a stated tariff for services rendered. So with gas or electric light or power.

Petty thieving of electric energy has been going on in Montreal, among other places, for some time, and although the companies have been aware of the fact they have hesitated to take action, for various reasons. Probably the chief reason is reluctance on the part of the companies to expose the wrong doings of any so-called respectable citizen. Also, under the circumstances, it is often difficult to prove theft. There is the further reason, too, that, strangely enough, the companies get little sympathy from the general public in such matters and are apt to lose customers or make enemies and so injure their business to a much greater extent than the petty dishonesty of a few can do. This phase of the question has deterred more than one company of which the writer has knowledge from taking any steps to prosecute offenders in the public courts. Every lane has its turning, however, and recently the Montreal Light, Heat & Power Company have decided to make an extensive inspection of their customers' premises and prosecute wherever guilt is found. Already a stiff sentence of three months' imprisonment, without the option of a fine, has been meted out to one of the offenders and it is said a number of other cases are soon to be dealt with. It is to be hoped other companies will be equally courageous and make this a time of general housecleaning. Quite aside from the financial loss, the removal of the evil influence of unpunished dishonesty on the moral tone of a neighborhood is quite worth the trouble required in locating and convicting the unscrupulous offenders.

Coast Developments

Judging from present indications the next two or three years should witness the development of an immense store of electrical energy in British Columbia. Scarcely a month passes without some announcement of importance relating to projected hydro-electric undertakings on a large scale in various parts of the province, and it would seem that if only a few of the power schemes already proposed reach the ultimate development planned, a period of unprecedented industrial activity in this part of the country will be the natural outcome. The latest electrical project is that announced by the Bridge River Company a recently incorporated concern backed by prominent Vancouver capitalists, which, in anticipation of the future power requirements of greater Vancouver and the probability of the electrification of the coast section of the Pacific Great Eastern Railway, plans to develop upwards of 200,000 horse power in the Lillooet district. It is proposed to build a large dam on Bridge River and to drive a tunnel one and three-quarters miles long through a mountain to an inlet on Seaton Lake. It has already been established that Bridge River, at the point where the dam will probably be built, is 1100 feet higher than the level of Seaton Lake. No engineering difficulties, it is expected, will be encountered in driving a tunnel for the intervening distance. The scheme was recently favorably reported on by Mr. W. C. Smith, engineer of the water rights branch of the provincial department of lands. Mr. Smith made a detailed examination of the Bridge River, which is a large mountain stream with an enormous drainage basin, ensuring a large water supply the year round. He was accompanied by Mr. W. R. Bonnycastle, of Vancouver, engineer of the power company, who is now engaged in completing all the surveys. Application for water records aggregating 100,000 acre feet have been made to the provincial Government. The project has also been favorably reported upon by other engineers. It is expected that the whole will involve the ultimate expenditure of approximately $8,000,000

Power transmission at long distance has been successfully solved and it is thought there will be little waste between the proposed power plant on Seaton Lake and Vancouver. The proposed power line will follow the route of the Pacific Great Eastern Railway Company and will be about 150 miles long. As the proposed power house will be less than forty miles from the main line of the C. P. R. and Canadian Northern Railways at Lytton, the promoters hope also to sell motive power to both lines. While nothing really definite can be learned at present with regard to the probable date of the commencement of operations, it is understood that active construction work will be started before the end of this year, or early in 1914. Two or three years are bound to

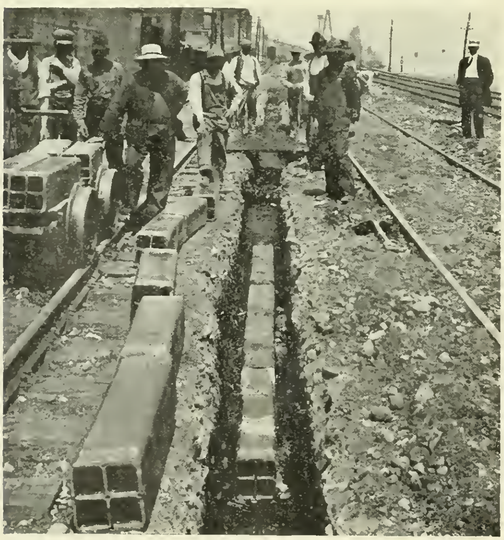
elapse however before the company will be in a position to supply power.

The Canadian General Electric Company, as already announced, has been awarded the contract for supplying the necessary machinery for the electrification of the C. P. R. line between Castlegar and Rossland in British Columbia. The intention is to use 2400 volts, direct current trolley system for electric locomotives, the power to be obtained from the plant of the West Kootenay Power & Light Company, Limited, at Bonnington Falls, near Nelson. The section of the line which is to be electrified is thirty miles in length and has very heavy grades and numerous loops. The funds for the improvement scheme were appropriated at the beginning of the year and it is proposed to have the work well under way this season.

C. P. R. Conduit Construction

With a view of eliminating the overhead transmission lines of the C. P. R. telegraph company and simplifying the signal system in the yards from Delorimier Avenue and Notre Dame Street to Ontario Street, Montreal, the C. P. R. decided to lay conduits between those points. It is obviously difficult to handle signal work in a large railway yard from overhead construction; conduits do away with delays from ice and snow inevitable in pole work, and although the capital cost is larger, the maintenance charges are by no means as heavy. The contract was carried out by Dietrich, Limited, Montreal.

The whole installation is located between two main lines entering Place Viger station, and involved work under two



Laying Conduit in Hochelaga Yard, C.P.R., Montreal.

bridges and over one subway. This point is a particularly busy one, and with the railway service being carried on during the entire period, the work was one of more than ordinary difficulty. The conduit is approximately one mile in length, and consists of 4-way vitrified clay duct laid in a complete envelope of concrete 3 in. thick. There are 16 concrete manholes 4 ft. x 5 ft. x 6 ft. inside measurement. The manhole space varies from 75 ft. to 575 ft., due to leads being taken off most of the manholes in order to operate the automatic signal system in the yards.

Almost from the start springs and quicksands were encountered, this necessitating the carrying of a 6 in. glazed tile drain for a distance of 2,600 feet. The drain was carried at a uniform depth of 6 feet from the surface, the entire yard being a grade of about one per cent. Fifteen pair 14 gauge, lead-covered, paper-insulated cable is used throughout.

Dietrich, Limited, have also completed the laying of two conduits in Toronto for the C. P. R. telegraph department. One on Dundas street west, Toronto, was notable for the large number of springs and quicksands, which involved the use of sheet piling throughout the job. In the other conduit, on Yonge street, the difficulty was due to the many wires and pipes. Besides gas and water mains, there were the lines of the Toronto Hydro, Toronto Electric Light Company, and the Bell Telephone Company, and a place had to be found for the C. P. R. conduit between these various wires and mains. The difficulties, however, were overcome, and the job successfully completed.

Further Plans Approved

The Quebec Public Utilities Commission, sitting in Montreal, have approved further plans of the Electrical Service Commission for placing wires underground. The conduits approved will be a continuation of those now being laid on St. Catherine street by Mr. G. M. Gest, the new section being from Guy to Atwater avenue; while the other conduits passed will run under Bleury street and Park avenue (from Craig street to Pine avenue).

Dr. Herdt, the chairman of the commission, explained the plans, stating that they might have to be varied a little as a great many obstructions were encountered that were not found in the city's records and street plans. At the corner of McGill College avenue and St. Catherine street (Mr. Gest's contract) they had an unusual amount of trouble on account of sewers and other pipes and conduits.

The new plans having been approved, tenders will be called for the construction of the conduits. The plans for the additional section of St. Catherine street are similar to those now being carried out, but a different system has been adopted for Bleury street. In conjunction with the civic conduits, one will be constructed for the Bell Telephone Company, the ducts being separated by 6 in. of concrete. The work will be carried out under the supervision of the Commission, the Bell Telephone paying the cost. In the civic conduits there will be a main run of 28 ducts with other laterals on the west side of the street, with a feed across at certain intersections to manholes on the east side, thence north and south for certain distances under the sidewalk for serving each building.

In connection with the Bleury street plan, a new lighting scheme will be installed, consisting of 41 standards. Police patrol and fire alarm standards will also be erected.

Westmount Conduit Work

The Westmount, P.Q., Council have awarded a contract to R. T. Smith & Company, Montreal, for the construction of a conduit on Western avenue. The conduit, designed by Mr. G. W. Thompson, the general manager of civic affairs, will be constructed of vitrified clay ducts, of 3½ in. square bore, and will cost about $25,000. It is probable that, in the future, the conduit will be linked up with the system which is now being carried out by the city of Montreal, under the direction of the Electrical Service Commission. Wires for the police call, lighting, fire alarms and any other lines through the city that may be required will be placed in the conduit. Manholes will be built in every section of the con-

duit. The ducts will be purchased by the council, and R. T. Smith & Company will carry out the work of laying. It is intended that the Western avenue conduit shall form part of a general system for the city, which will involve the removal of the poles. The amount to be expended at the present time will be charged to the surplus arising from the electric lighting department, and for this purpose the amount set aside against depreciation of the electric plant will be reduced from eight to four per cent. annually.

In connection with the scheme, the city are installing on the same avenue 50 standard inverted magnetite arc lamps, manufactured by the Canadian General Electric Company. These are 14 feet high, and will replace the present bracket arc lamps.

A Prussian Government Water-Power Project

The Prussian Parliament has recently enacted a law appropriating $2,500,000, for developing water power on the upper reaches of the River Weser in Hanover Province and Waldeck Principality. It is proposed to utilize the water heads afforded by the already existing reservoirs at Hemfurt on the River Eder and Helminghausen on the Diemel, both source streams of the Weser, and later to connect these power plants with a third to be built at Munden, where the conflux of the Rivers Fulda and Werra gives rise to the Weser proper. In keeping with the more recent Prussian policy of direct development of water powers by the State, the waterways department of the Prussian Ministry of Public Works will undertake not only the construction but also the subsequent sale, up to a certain point, of the power to be developed.

Proposed Equipment of Plants

The reservoirs at Hemfurt and Helminghausen were built by the Prussian Government in connection with the construction of the Rhine-Hanover Canal under the law of April 1, 1905. When full the reservoir at Hemfurt imprisons 1,975 million gallons of water and the water head at the dam is then 135 feet. The reservoir at Helminghausen holds 194 million gallons of water when full. The maximum head is 114 feet. The hydro-electric station to be erected at Hemfurt, according to the present plan, will be equipped with six turbines, developing each 2,500 horse-power at a 105-foot head, six 2,300 kilowatt generators and three 5,000 kilowatt, 6,000-40,000 volt transformers. The cost, including machinery, buildings, and all accessories is estimated at $452,500. The station at Helminghausen will be equipped with two turbines, each developing 600 horse-power and one developing 1,200 horse-power at a 90-foot head, two 600 kilowatt generators and one 2,000 kilowatt, 6,000-40,000 volt transformer. The cost of this station is estimated at $95,200.

The third station—to be built later on the Weser at Munden—will cost with its various accessories $892,500. The machinery installation will include six turbines, three developing 1,240 horse-power each at a water head of 12.7 feet and three developing 460 horse-power at a head of 6.9 feet; three 1,200 kilowatt generators; and two 4,000 kilowatt, 6,000-40,000 volt transformers. In addition, a canal will be made at an estimated cost of $183,736, exclusive of land value, and a 656-foot lock constructed at a cost of $133,280.

The project contemplates the eventual linking of these three stations by a high-tension transmission line to cost $226,100. The total power which the combined plant will then be capable of delivering is 41 million kilowatt hours a year. As the maximum water flow available during the various seasons does not coincide, however, with the fluctuations in the demand for power, it is calculated that a yearly consumption of 29 million kilowatt hours can be taken care of without resort to a steam reserve. The prospective initial demand does not warrant so large a plant, and it is proposed accordingly to build only the Hemfurt and Helminghausen stations at present and to connect these with the steam-driven, electric-generating plant of the Prussian railway administration at Cassel, and possibly also with the municipal steam plants at Cassel and Gottingen, from which supplementary power can be drawn as the need arises.

How Current Will Be Sold

It is considered that the interests of the local inhabitants will be better served if the State itself delivers the power to the surrounding county governments for further distribution than if it is sold at once and entire to some private distributing concern. Direct sales will be made to the Prussian railway establishment at Cassel (station, yards, shops, etc.), and also, it is expected, to the cities of Cassel and Gottingen. Under the proposed arrangement the existing steam plants at these points will be allowed to remain idle except when, owing to low water or heavy demand, they are called upon to assist the water-power stations. Electricity will be sold to the two cities and the railway administration at 0.714 cent per kilowatt hour and purchased from them when needed at 1.428 cents. According to estimate it will be necessary at the outset to buy only 2 to 3 per cent. of the total current consumed in any year not attended by unusual water conditions. It is possible that in the future direct sales will be made to other large establishments, such as manufacturing plants, etc., but for the present, except in the three instances noted, the power will not be sold to ultimate consumers, but to the county governments or to companies formed in one or more counties under special provisions of law.

The region to be served includes 13 counties in Prussia and 3 in Waldeck, representing a total area of about 2,500 square miles and embracing a population of about 600,000. It is estimated that approximately three-fourths of the prospective demand will be municipal and industrial and one-fourth agricultural. The current will be distributed to 15 points within this region by means of a 40,000 volt transmission system, which will be about 215 miles in total length and will cost to construct about $405,000. At each of the 15 points mentioned there will be a transformer station, where the current will be stepped down from 40,000 to 6,000 volts and delivered to the county governments or companies.

Cost to State of Electricity Developed

Calculated on the basis of five stages in the growth of demand, the cost of the electricity to the State at the transformer station switchboards will be as follows:

Stage	Yearly Consumption Kilowatt hours	Per kilowatt hour Cents
First	10,000,000	1.2
Second	20,000,000	.862
Third	24,000,000	.888
Fourth	30,000,000	.807
Fifth	40,000,000	.745

The Munden station will be built when the consumption approaches 24,000,000 kilowatt hours, so that the higher per unit cost at that stage, attributable to the necessity of purchasing large quantities of steam-generated electricity, will never be actually encountered.

On the basis of these cost calculations it is proposed to sell electricity to the counties at 1.428, 1.19, and 0.952 cent (6, 5, and 4 pfennigs) per kilowatt hour, according to the amount consumed. Forty-year contracts are being made by the terms of which the counties or special companies formed therein undertake to purchase minimum amounts of power at the prices named and to distribute it to the ultimate consumers at 220 or 120 volts, as conditions require. They will be able to do this profitably, according to estimates, at 10.7 cents per kilowatt hour for light and 4.76 cents for power to small consumers and at considerably reduced rates to large consumers. The cost to the counties or companies of the equipment and

(Concluded on page 44)

Discussion on New Hydro-Electric Rules

At the recent Convention of the Canadian Electrical Association an interesting criticism of Mr. Strickland's paper on the new Hydro rules was read by Mr. S. Bingham Hood. Mr. Hood's criticism and Mr. Strickland's reply are printed below. The discussion is of unusual interest as throwing more light on a subject of vital importance.

Mr. Hood's Criticism

Some months ago a Committee, representing the Toronto Section of the A. I. E. E., was called together to discuss the proposed rules of the Hydro-electric Commission. This Committee was composed of men whose technical training made them thoroughly familiar with wiring and apparatus as covered by the proposed rules. The objections then raised to the rules, as then proposed, were so extensive that the Commission agreed to revise them and again submit them to the Committee for reconsideration.

The revision has apparently been made in some cases, but as far as I, a member of the Committee, know, they have never been re-submitted, and apparently the Institute has been ignored in the adoption of the final draft. This would appear to be a breach of good faith, and one which certainly should have the consideration of this Association, being so closely allied in its interests to that of the Institute. If our representative electrical bodies are to be ignored in the matter of formulation and adoption of rules in which they are so vitally interested, they can hardly be expected to show any very enthusiastic co-operative spirit.

The principal objection which is, and must always be, raised against these rules, irrespective of their fairness, or apparent fairness, is that their interpretation is in the hands of the most interested party. In the case of a city or district served by competing municipal and private companies, the chances for unfair discrimination are so self-evident that the fairest interpretation in the world must always be open to question. The fact that an appeal can be made to the Commission as a final resort is somewhat ludicrous, in that the court of appeal will, in most cases, be a joint partner with the municipality operating the inspection bureau. This point is brought to the attention of your Association merely to show in advance one of the difficulties our esteemed friends are going to run up against.

Generally speaking the rules, as now issued, are a credit to the men who have gotten them out, and closely follow those of the National Code, including the profuse explanatory notes which were so prominent in the old Code of some years back. These notes will no doubt be of immense value to the novice who is engaged in interior wiring so generally, and will also serve as a reminder to many of us who have been at the mill so long that we may have forgotten some of the points so carefully brought out.

There are two excellent rules embodied in this book—first: neutrals must be grounded; and, second: fuses must be omitted from these neutrals. This shows that the Commission have recognized the dangers of the omission of the first item and insertion of the second.

Unfortunately, however, they have stopped just too soon to make a good job of it. Having provided for keeping the neutral closed, and realizing the danger of its being opened, they tell us in the third paragraph on page 2 that we must insert the generator protection in the grounded leg, and again on page 26, rule (j), they specify a switch in every leg of the circuit. If it is dangerous to open a neutral with a fuse, why is it not equally dangerous to do the identically same thing at the switch? Again in rule (g), page 24, the same neutral that is required to be made solid in the three-wire line must be fused, simply because one of the outers is dropped off the circuit and the balance of the same circuit carried on to the utilization point. Why, in commonsense, can we not be allowed to kill two birds with one stone and make our system both cheap and of the utmost safety by using a solid common neutral supplying every utilization outlet? If we were allowed to do this, it would be but one step further to reach the ultimate point of cheapness and safety by making this neutral of bare conductor, heat insulated only from its supports. It is a regrettable feature of both these rules and our old friend, the National Code, that their makers (like all large bodies), move slowly. It has taken over ten years to get our neutrals grounded and get rid of the neutral fuse, and will probably take ten more before we will be allowed to use a common-grounded neutral to the same extent that has permitted the electric railway interests to operate their ground return system with the utmost simplicity, safety and reliability from its inception.

On page 113, rule 2, section (b), is interesting in that a two-wire circuit must be grounded up to 150 volts, but a three-wire system must be grounded with the sky the limit. This is no oversight, as shown by rule (h) on page 115, where over 150 volts may be grounded by special permission, with particular attention called to the fact that this does not apply to former rule (b). This point is mentioned as a discrepancy, and not as a criticism, as I firmly believe in grounding the neutral of every circuit irrespective of its voltage.

On page 52, section (h), the requirement of 2500 volt insulation on all service conduit leads over 150 volts is going to prove very detrimental to the use of 3-wire, 115/230 volt services. Similar discrimination is shown in the matter of meter and service equipments on page 57, rule (n), where metal enclosed switches and cutouts are necessary on a 3-wire service. This requirement should certainly not have been applied up to 300 volts, which would have covered all ordinary lighting services and given a factor of safety of 400 per cent. on standard 600 volt wire. The service illustrations of figures 18 and 21 have apparently been designed with the understanding that electricity is now so cheap in Ontario that no one but a fool would take the trouble to steal it. Rule (a), page 46, evidently has this in mind also, where it requires the switch to cut off current from everything, including meters. The central station must have control of the supply up to the meter and must maintain current on the meter at all times. Ample protection for the meter is provided by the sealed service fuse, and no exposed live contacts can be permitted on wires or apparatus carrying unmetered energy. Hundreds of thousands of dollars have been expended in the past few years in the development and installation of sealed service equipments, all designed with the switch after the meter. The largest company in the States turning out this line of fittings (and now operating a factory in Canada), has for its engineer the manager of the largest central station company in the world, whose experience along this line is beyond dispute. It will be interesting to watch the effect of the enforcement of this rule, which means the confiscation of practically every dollar's worth of apparatus now developed and used in direct contradiction to the rule. The National Code ruling of similar wording is now practically obsolete, owing to the opposition from the Class A members of the N.E.L.A., and I imagine the Ontario Commission's engineers may look for squalls ahead.

Another point, which has been recalled to my attention by listening to the paper on electric heating devices, is the adoption of the old Code rule of 660 watts and a six ampere fuse for branch circuits.

The rigid enforcement of this rule would have a serious effect on the use of appliances designed for attachment to ordinary lamp socket outlets. In practice the usual result of trying to enforce this impractical rule is the ultimate substitution of copper cents, or other make-shifts, for the original fuse which would not carry the load.

It is past me to understand why, when we are limited to

a minimum size of wire which is rated and approved for 15 amperes, we are not permitted to fuse this wire to over 6 amperes, or less than one-half its safe carrying capacity.

As promised at the Convention, Mr. Strickland has prepared the following reply, copy of which he has forwarded to the Electrical News.

Mr. Strickland's Reply

It is true that the commission submitted the first edition of proposed rules and regulations to a committee of the A.I.E.E., Mr. Hood being one of the members of that committee, and whether or not they re-submitted it to this committee should not be the basis of a discussion at the N.E.L.A., and any alleged breach of faith with the A.I.E.E. cannot possibly be construed as a breach of faith or one of co-operation with the N.E.L.A. As already explained there was no breach of faith anywhere that we can see, as the Commission certainly did not leave a stone unturned in submitting the rules to the electrical fraternity at large.

Mr. Hood then alludes to an alleged objection to the Hydro Commission having the power of administrating these rules and regulations, claiming that there will be a discrimination in the favor of municipalities in which Hydro power is used. Now, if it is in the interest of private lighting companies to have their electrical installations inspected and kept up to the standard, I would ask Mr. Hood, in the name of common sense, why the Hydro Commission plants are not just as equally interested. He refers again to a ludicrous situation being developed in an appeal to the Commission in a case of dispute, owing to the fact that the Hydro Commission are in a measure partners with the municipalities, maintaining the inspectors. I am again at a loss to account for such a deduction, any more than it would be ludicrous to appeal to the magistrate of any one of the Hydro cities. For instance, we will suppose that a Hydro employee and a private plant employee are both summoned before a magistrate in a Hydro town for some offence; we will say, as an illustration, that of disorderly conduct, it would be just as reasonable to assume that the magistrate, being employed by the Hydro municipality, would dismiss the Hydro employee and fine the employee of the private corporation.

We now come to that part of Mr. Hood's comments where he compliments the Commission on their excellent rules and regulations. I really feel that this is the heart of his address, because at one sweep he says that the Commission are to be congratulated on their excellent rules and that they are a credit to them. For this compliment coming from such a well-known authority as Mr. Hood, and from the ranks of the enemy, we feel very much gratified, as a lot of time and thought has been expended in producing a set of regulations which will be at least as good as anything we have at the present time. Touching upon the next comment, regarding the grounding of neutrals, Mr. Hood claims that we have done well in this respect, but stopped a little too soon to make a good job of it. There is only one answer to make to this comment and that is, this,—it would not be advisable to suddenly introduce a lot of sweeping changes, although there may be further developments to be looked for before long. There is nowhere in our rules and regulations that the Commission claims a finality to their regulations, and they certainly do not intend to stand still and let the grass grow under their feet, but will keep all rules and regulations well up to the times.

The next comment was the grounding of secondary distribution systems. Mr. Hood claims that the "sky limit" has been placed on this method of grounding. I can only say that the sky limit is rarely ever used on secondary systems and there are few, if any, in this country where the differences in potential exceeds 150 volts. Mr. Hood, however, only refers to this as a slight discrepancy, and if there is anything wrong with it it is a National Code rule and not a Hydro rule and he will have to blame the Fire Underwriters as the authors thereof. Regarding his comment on 2500 volt insulations in service pipes, Mr. Hood says this will be detrimental; but as he has failed to say in what way it will be detrimental I have nothing to answer. So far as I can see it only makes matters a little better than they are at present, and has a tendency to prevent the dangerous burnouts, a good example of which can be seen illustrated in our book of rules and regulations, and which, no doubt, is very fresh in the memory of Mr. Hood.

Regarding the protection of meters and the relative position of main switches, I can only answer this criticism by stating that it is a National Code rule, and that whatever the merits of Mr. Hood's criticisms may be, we did not at the present time deem it advisable to make any rules which were a direct violation of the National Code.

We quite agree with Mr. Hood that the National Code rule is somewhat behind on this point, and we will undoubtedly be able to find a remedy for this difficulty sooner or later. Mr. Hood refers to the question of placing a circuit breaker in the grounded pole of a generator. He states that we do not permit a fuse in a grounded neutral, and yet require it in the ground pole of a railway generator. This is a National Code rule also. When I first saw it I concluded that there was something wrong about it myself, but have before me the correspondence between the Commission and the Underwriters Committee of Boston, in which they defend their claims for the rule, so that at the present time we had no option but to leave the rule as it stands in the Code. (Edition 1913, not yet printed). These seem to be the chief points in Mr. Hood's criticisms, and I would summarize the situation as follows:—

At the very meeting, at which Mr. Hood was present, already referred to, one of the chief points raised, and unanimously agreed to by all present, was that the Commission be requested to rearrange their rules and regulations in such a way that there would be no confliction with the National Code of the Underwriters. I was present at this meeting, and Mr. Gaby, who was there also, promised the members of the committee that the book would be redrafted along the lines of the N. E. code. This has now been faithfully carried out, and all the violations of the N. E. code which were in the original book have been corrected. It now seems strange that when the Commission have so faithfully carried out the request of this committee, of which Mr. Hood was a member, that they are charged by one of the committee with having done the very thing which the committee and Mr. Hood requested them to do, and let me assure the readers of this magazine, and members of the N.E.L.A., that it has always been the wish of the Commission that the rules and regulations shall be approved and acceptable to the electrical profession as a whole, and it has been my earnest desire to not only carry out the wish of the Commission but to see that the book of regulations is a credit to my employees, and also as effective as any other similar edition to be had anywhere.

We have now before us the unqualified approval of the Electrical Associations of this Province duly signed by men who are members of the N.E.L.A., and Mr. Hood's adverse comments and charges of breach of faith were somewhat like a bolt from the blue; but let me assure him, however, that we are quite prepared and it is to be expected that there will always be somebody who may raise suggestions or comments. These are always welcome and will be placed on file and seriously considered from time to time, but in view of the fact that the Commission have shown their willingness to consider every interest at stake we hardly looked for a rap of this kind. It is, however, a source of gratification to know that in all the criticisms which Mr. Hood has

(Concluded on page 44)

The Purchase of Coal Under Specification

Within Recent Years Purchasers are Regulating the Quality of Coal by Specifications and Tests—Useful Test Data

By Mr. J. A. Copp*

It is only within very recent years that purchasers of coal have regulated the quality supplied them by the formulation of specifications and by systematic inspection testing. Buyer and seller had previously looked upon coal as a gross commodity, and it was bought and sold largely on reputation.

Trade or brand names were a valuable asset in selling; and frequently the reputation of a trade name or brand lasted long after the deposit of coal, upon which the brand had originally been established, had become exhausted, or had changed materially in character as the coal was obtained from deeper or more distant parts of the workings. The mining companies did not generally employ chemists to make regular analyses of the output of their mines; and about the only knowledge they had of the composition of the coal they were mining was of the most general sort, obtained either from the records of analyses made by the State Geological Surveys, or from occasional reports by customers. That the coal from different mines varied greatly in composition was well known, but it was recognized that the miner could do little to change his output. In fact, all he could do was to exercise care in mining, and to remove the foreign matter mined with the coal; and, by this care and preparation keep down the ash and sulphur toward the minimum which could be expected from the output of any given mine. The buyer was welcome to all the information the seller possessed, but it was too little to enable him intelligently to make selection among the various kinds of coal offered him at a rather wide range of prices.

A typical analysis of bituminous steam coal may be quoted.

Moisture	2.05%
Volatile matter	23.63%
Fixed carbon	69.36%
Ash	7.02%
	100.00%
Sulphur	1.25%
Thermal value	14,540 B.t.u

The moisture is more or less accidental, and may vary with so many circumstances that for most purposes it may be disregarded, being set down for information only. It is of moment only when the unit of delivery is a wagon or truck, and when the coal is weighed as it is being delivered. The proximate composition is then given on the basis of "dry coal," as representative of the coal as it really exists free from the accidental moisture. The sulphur must be separately stated, since it may be either in the volatile matter or in the ash, or more likely in both.

The volatile matter is mainly combustible, although a certain proportion is generally inert. It is of interest chiefly because of its influence on the behavior of the coal as furnace fuel. The boiler-setting and furnace are frequently such that coal high in volatile matter cannot be burned economically, especially under forced firing, and without the production of a prohibitive amount of smoke. Coal high in fixed carbon (and hence correspondingly low in volatile matter) is more easily and uniformly burned under general conditions.

Ash is inert, and may be considered a direct expense. It is paid for at the price of combustible fuel; and, when in too great proportion, it interferes with air distribution throughout the fuel bed. When, because of composition, it is of a fusible nature, it causes clinker formation, the removal of which necessitates undue prolonging of the time of opening of the furnace doors, with consequent loss of heat. Its removal and disposal is a supplementary expense.

Sulphur may exist in a free state, in which case it is relatively unobjectionable, but it is usually in combination in the ash and may increase the clinkering tendency of the coal. By proper care in preparation both the sulphur and ash can be kept down to as low a point as is possible with the coal from any individual deposit.

Considering coals of proximate composition and general character such that they may all be burned with substantially equal ease in a given furnace, their theoretical fuel efficiency will be in direct proportion to their thermal values, usually expressed in British thermal units (B.t.u.).

These data obviously make possible comparison of coals from different sources and, when supplemented by the results of practical experience in the burning of various sorts of coal in any particular installation, afford a means of estimating the relative value of coals of different character as fuel for that plant. Hence the analysis and thermal value form an excellent basis for purchasing specifications; and such specifications, having been found mutually helpful to buyer and seller for all other sorts of materials, have come into use for coal.

The specifications first prepared, and many of those in force to-day, fix the proximate analysis of the coal desired, and provide for payment of the coal delivered on a sliding scale above or below the base price as quality varies, and especially as the thermal value exceeds or runs under the figure fixed in the specifications as the standard. This form of specifications, however, is inflexible, and does not permit consideration of coals which might be excellent fuels, but would not meet the fixed requirements. Such coals either would be rejected for not conforming to specifications, or would be penalized prohibitively in price. Furthermore, it must be recognized that geographical location determines to a large extent the character of fuel that is available at any particular point. This follows from the fact that the distance from the coal fields and transportation facilities fix pretty closely the district from which coal for that locality must economically be drawn: if brought from other districts, the freight charges will be too high. In localities at considerable distances from the mines, the freight is from two to four times the cost of the coal f.o.b. mines. For these reasons many specifications have been so drawn that the bidder states the average ash, sulphur, B.t.u's., etc., in the coal he proposes to furnish, and this statement becomes the basis of quality.

In all of the specifications with which the author is familiar, adjustments in the price to be paid for coal delivered are made for variations in quality. In this respect, coal specifications differ from those used for the purchase of any other material, except, perhaps, pig iron. Such adjustment is necessary because it is seldom easily possible to reject coal, since in many cases the delivery has been unloaded, and may even have lost identity by the time the analysis has been made. A delivery poor in quality must usually, therefore, be accepted; and it is but just and fair that the price be lowered in some degree, commensurate

* Chief of Testing Laboratory, General Electric Company.

with the lowering of grade below that contemplated in establishing the base price under the contract. An increase in price is equally merited if the delivery is of materially better quality than the standard.

The variations in quality to be provided for are, then, in the percentages of ash and sulphur, occasionally also of volatile matter, and in the thermal value, or B.t.u's. There are many ways of providing for adjustments in price because of fluctuations in quality. The majority of the specifications are based on the assumption that the price should rise and fall directly with the thermal value. Hence, taking the base price and the established standard of the contract, there are calculated the number of B.t.u's. for 1c. in a ton of coal at base price. The price of deliveries is modified as the analysis shows B.t.u's. higher or lower than the standard. A further modification is made for ash, sometimes by a scheme of proportion, sometimes by fixed deductions or additions according as the ash exceeds or is under the standard by fixed amounts or ranges. Adjustment is usually made for sulphur by fixed deductions for stated amounts or ranges by which the sulphur exceeds the standard.

Price Varies with Heat Value

Theoretically, the direct variation of price with variation in thermal value is correct. It is based, however, on the assumption that the actual fuel value varies directly with the thermal value. It is obvious, however, that it is not practically possible to realize the gain or loss in a power station from relatively small changes in B.t.u's. in the coal, because there are too many other uncontrollable variables to be taken into account. Certainly the stoker cannot take such changes into account, and its operation cannot be regulated accordingly. Furthermore, such fluctuations in thermal value as are found in shipments of carefully mined, well-prepared coal from any given mine are accidental and beyond the control of the miner. Naturally it is preferable to be able to sell one's wares at a fixed price throughout the life of a contract, and there is a certain minimum below which the sale is not profitable. The tendency, then, is for the price to be set so that any penalties which may be incurred will still leave a figure above this minimum, notwithstanding the fact that the law of averages would indicate that premiums and penalties would balance if the standard had been fairly set at average. The same lack of fixity in price leaves the buyer uncertain as to his costs; and, whenever premiums are earned, he is left in doubt as to whether he is actually getting his money's worth. He seldom can show it by lessened coal consumption or increased steam production. This same reasoning may be applied in large degree to ash, sulphur and volatile matter.

Before discussing further the question of price adjustment under specifications, it may be well to turn attention to an equally important matter. Obviously, the successful application of any form of specifications depends wholly upon the ability to obtain samples which represent fairly the quality of the coal delivered. Much has been written upon the question of sampling coal; and the difficulty of obtaining by hand a truly representative sample of, say, a carload or barge of coal is admitted. A second sample to check the first, in case of dissatisfaction with results, is usually not possible for the same reason that coal can seldom be rejected—it has been burned, or at least has lost identity, by the time results are obtained. An automatic system by which samples are obtained from all parts of the unit of delivery, whether car or barge, and which takes out a large number of thoroughly distributed small quantities, yields about as fair and representative a sample as can be obtained.

A third point requiring consideration in preparing specifications for the purchasing of coal is the unit of analysis. In cases where the contract is filled by a few deliveries over a considerable period, the delivery itself may conveniently be the unit of analysis, and the price to be paid for each delivery may easily be determined. Similarly, if the unit of shipment is a large barge or lighter containing several hundred tons, the unit of analysis may well be the unit of shipment. But where deliveries are in carloads of approximately forty tons each, and where the normal rates vary from four to perhaps twenty cars per day, depending upon the way shipments are made and the requirements of the buyer, it is seen that some scheme must be worked out to take care of wide fluctuations in receipts. The matter may be complicated by shipments coming in from two or three or more contractors at the same time. In such a case, which is by no means rare with industrial establishments, the laboratory cannot possibly be flexible enough in equipment with men and apparatus to handle analyses upon samples from each car as a unit, and provision must be made for sampling and analyzing at such intervals that the work may be carried out under commercial conditions.

The industrial establishment with which the writer is connected has studied the problem of coal specifications for several years, two or three different types of specifications being tried out in the course of evolution. In the specifications last adopted are embodied several schemes which are novel, and which have solved the difficulties discussed in a manner which has worked out very satisfactorily.

First, with respect to the standard, the contractor states the average composition and heat value of the coal to be delivered; and agrees "that this average composition and heat value shall be the standard basis of quality of the coal delivered." No restrictions upon either chemistry or thermal value are imposed in the tenders, but bids upon any coal offered are considered. Acceptance or rejection of bids is based upon the quality guaranteed and the price quoted.

Second, sampling and analysis. Samples are obtained automatically from the cars as they are unloaded at the power stations. The coal drops from the car into hoppers, discharging through rolls by which the coal is crushed before being conveyed to bins feeding the stokers. In one station the sample is obtained by the opening of a small trapdoor in an incline down which the crushed coal slides to the conveyor. In the other station, where the crushing rolls discharge directly onto the conveyor, the sample is taken by a small one-bucket conveyor, or "thief," which dips a small amount of coal from a conveyor bucket at regular intervals. In either case the sample is dropped to a receptacle which holds the entire 180, more or less, little portions that are taken from all parts of a car. This sample is then passed through a grinder by which it is reduced to about 16 mesh and finer, and then put through a mixing machine. Any reasonable portion of this 40-lb. sample is then as thoroughly representative of the car as it is possible for any sample to be. A 2-oz. sample is taken from this car sample to represent the car in the final analysis. The 2-oz. samples from all of the cars sampled during any calendar month, and representing the delivery by any one contractor, are then thoroughly mixed and quartered in the customary manner until a final average sample of about one pound remains. "This final average sample shall constitute the sample upon a portion of which analysis, shall be made to determine the average character of the coal received during the month, and upon which settlement shall be based." In this way the utmost flexibility is provided for handling the greatest variations in the number of cars delivered.

Third, basis of settlement. No clearer idea may be given for the provisions in the specifications for adjustment of price for variations in quality, than by direct quotation:

Settlement for Coal

"Settlement for coal received during any calendar month shall be made after the completion of analysis of the average sample representing coal received during said month, and not later than the fifteenth day of the next month. The price

per ton to be paid by the purchaser shall be the base price quoted by the contractor, with deductions and additions for variations in quality, and for failure to deliver in drop-bottom cars, as hereinafter provided."

"When the analysis upon the average sample for any calendar month shows that the percentage of ash is not more than one higher or lower than the standard average percentage, and that the percentage of sulphur is not more than 0.25 higher than the standard average percentage, and that the thermal value is not more than 150 B.t.u. higher or lower than the standard average B.t.u., then settlement for the coal received by the purchaser during said calendar month shall be made at the base price, without additions or deductions for quality. When the analysis shows that the percentage of ash is more than one lower than the standard average percentage, then an addition of 2c. to the base price per ton will be made for each 0.50 or fraction thereof, that the percentage of ash is more than one lower than the standard average percentage; and when the analysis shows that the percentage of ash is more than one higher than the standard average percentage, then a deduction of 2c. from the base price per ton will be made for each 0.50, or fraction thereof, that the percentage of ash is more than one higher than the standard average percentage. When the analysis shows that the percentage of sulphur is more than 0.25 higher than the standard average percentage, then a deduction of 2c. from the base price per ton will be made for each 0.25 or fraction thereof, that the percentage of sulphur is more than 0.25 higher than the standard average percentage. When the analysis shows that the thermal value is more than 150 B.t.u. higher than the standard average B.t.u., then an addition of 1c. to the base price per ton will be made for each 50 B.t.u. or fraction thereof that the thermal value is more than 150 B.t.u. higher than the standard average B.t.u. When the analysis shows that the thermal value is more than 150 B.t.u. lower than the standard average B.t.u., then a deduction of 1c. from the base price per ton will be made for each 50 B.t.u. or fraction thereof that the thermal value is more than 150 B.t.u. lower than the standard average B.t.u."

Specifications founded on Average

It is seen that the specifications are founded upon averages, and the idea of averages includes a certain expected variation. The record of a large number of analyses made over a period of several years has shown that the limits set in the specification, within which there are neither additions to or deductions from the base price, are sufficiently wide to cover the variations that should reasonably be expected from carefully mined and prepared coal, at least from the district from which coal is customarily shipped to Schenectady. At the same time, experience has shown that acceptable coal which falls within the limits of the "base zone" of the specifications is good commercially acceptable fuel, and that there is no warrant for any change in price of coal which does not vary more than the limits to the "base zone." Coal which does vary more than these limits is either of distinctly better quality and should earn a better price, or of markedly poorer quality meriting a reduced price.

The object of purchasing specifications is two-fold: first, protection against unscrupulous or ignorant competition, by insuring a common basis for all bidders; and, second, the provision of standards by which deliveries may be evaluated, thereby insuring the acceptance of good material and making provision for the rejection or other disposition of that which is below the standard established. The standard established, then, should be such that, while it is high enough to insure safe and satisfactory service in the use for which the material is intended, it may be reached by recognized commercial methods of making and marketing. The specifications should provide a continuous supply of satisfactory commercial material at the lowest price at which such material can be furnished; and, during the term of the contract, there should be as little disturbance as possible either in quality or price. The specifications quoted were drafted to meet these conditions; they call for good commercial coal for which a fair price is to be paid, and make provision for an adjustment in the price only under what may reasonably be called extraordinary conditions. Purchases made over a period of over three years under specifications embodying the principle of the "base-zone" have shown their fairness by the fact that settlements have been made at base price in the greatest number of instances. Obviously, the bidder must state his "standard average" fairly and correctly. If the quality is set too low in the hope of getting additions in settlement, the price will be too high to be consonant with the quality offered. If the bidder sets his quality too high, so as to make and attractive looking bid, he is automatically paid a proper price when his delivery is poor. Furthermore, privision is made for concellation if a contractor continuously furnishes coal warranting deductions of 4c. or more per ton. When the standard average is properly stated, both buyer and seller may count upon the delivery of good coal at a fixed price.

During the next few months the C. P. R. telegraph department will string 775 miles of new wire on the western lines. Calgary is to be the central point for the lines to all parts east and west of the system. By the close of the summer the company will have 2,280 lines of its principal track in western Canada operated by telephone. The wires will be used from Calgary for this purpose in the near future.

A Prussian Government Water-Power Project

(continued from page 39)

installations for this final distribution is roughly estimated at $3,300,000 to $3,800,000 or on the average about $238,000 for each county.

The investment by the State includes the generating plant and the high-tension transmission system. The original bill laid before the legislature appropriated for this purpose $2,-142,000, of which $1,190,000 was to be expended at once and the balance when the construction of the station at Munden was taken up. On this basis it was expected that the State would realize on its investment somewhat less than 2 per cent. in the beginning and 6 per cent. when the fifth stage of current consumption was reached. The bill was amended by increasing the appropriation $357,000 for use as the need arises for extending the high-tension transmission system to other counties and cities desiring to purchase electricity from the State. The return which the State may realize on its investment is limited by law to 6 per cent. Any further surplus must be devoted to the reduction of rates. The counties, it is calculated, will be able to realize under the proposed terms an average of 5.25 per cent. on their investments.

Mr. Strickland's Reply

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made there is not one word against our own production, as they are entirely directed against rules which have been adopted at the request of the electrical interests from the old National Electrical code. In conclusion let me assure the parties interested that bona fide suggestions will be received at all times, and as soon as the system of inspection is well organized we feel that the electrical fraternity at large will have every reason to feel that the interpretation and administration of the rules and regulations will be carried out in a fair and impartial manner, and that there need be no apprehension that the electric lighting companies are going to get a raw deal. I hope, therefore, that this reply to Mr. Hood will have a tendency to clear up this slight controversy and all will be well that ends well.

Organization of an Appliance Department

Under present-day conditions the dealings of distributing companies with their customers carry heavy obligations.

By Mr. B. E. Rowley*

It has been stated at light and power companies' conventions that under present day conditions the dealings of companies with their consumers carry obligations and responsibilities far beyond anything dreamed of in the old regime.

If it is your desire to build up and foster a spirit of friendliness and confidence on the part of your consumer it is essential that you take the initiative.

When through your representatives you give smiling greeting to every one of your patrons it will go fully as far toward establishing the relationship you desire as will a cut in lighting rates.

Make your appliance salesman a part of your "service."

Your appliance salesmen, through self interest, are certain to be liberal with their smiles and keen at overcoming any prejudices against you.

You might emphasize your attitude of friendliness by instructing them to make careful note of complaints and see that the proper department follows and adjusts them.

During the winter months particularly, fifty per cent. of the women are telling their neighbors that their light bill is outrageously high. At least forty per cent. of this number may be convinced to the contrary by a man who has been properly coached.

Much irritation is caused, unknown to you, by hurried supply clerks in answering complaints and in talking, more particularly over the telephone, with unreasonable customers.

This unfortunate frame of mind on the part of the customer may be largely corrected by a salesman whose first effort, if he hopes to make a sale, must be directed toward convincing his customer of the friendly attitude of the company and in getting her in an amiable frame of mind.

Just recall the time and money you have spent or may yet spend in moulding public opinion on these phases of your business; revision of rates, poles vs. conduits, franchises, tax assessments, municipal ownership and, incidentally, appraisements, competitive companies, pole permits and regulations, objectionable ordinances and other vexing problems.

The determination of all of the subjects is either affected or influenced by public opinion.

If you employ the right calibre men for a house to house canvass and they are properly instructed, the day is certain to come when at a critical point their efforts will have turned the scale in your favor, and then, just for good measure, they are actually making revenue for the company while so engaged.

Demonstrations

Public demonstrations are profitable as they educate the ladies in the use of appliances and are the means of making many sales.

A large attendance can always be obtained by sending out numbered announcements and offering one appliance free to the lady who has the prize-winning number. These announcements have printed upon them a list of appliances to be demonstrated and the invited guest is instructed to mark with a cross the one she prefers. She then signs her name and address and these cards are collected upon her arrival and at the conclusion of the demonstration the prize is awarded to the one holding the fortunate number.

These cards are later distributed among the salesmen and are used as leads for future business. If this plan is followed in conjunction with an active house campaign each will help the other and the returns will be highly satisfactory.

A demonstration of appliances makes an impression that will stick in the minds of those who witness it for many years. They are there made to realize the great strides being made in Domestic Science.

A half-hour talk should be given on the use of electrical appliances generally and followed by a practical demonstration by capable demonstrators of each appliance. Toast can be quickly prepared and served. Corn may be popped and passed around. Coffee making with a percolator always fascinates the spectator. A water heater will quickly start the water boiling so that it can be seen by all. Dainty fabrics should be ironed. A washing machine could be in operation. A Vacuum Cleaner should be a drawing card to the housekeepers.

An office demonstration of electrical appliances may be made specially interesting if held in the evening.

You could adopt the plan of asking dealers to furnish ornamental lighting fixtures and lamps for a lighting display to be made at the time of the demonstration.

This gives the dealer an opportunity of obtaining new business, encourages a more elaborate lighting system in houses and brilliantly illuminates your display.

If you have in your company or in your employ a man who can deliver a short address on correct and economical lighting plans for residences and who will discuss the history and theory of electricity as applied to cooking and heating appliances, it will help make the evening profitable for those who are present.

Music and a few flowers will help make the occasion noteworthy and the cost would be nominal. You will find that a demonstration of this kind will justify considerable space in the news columns of your local papers.

Terms of Sale

The perpetual earning capacity of the Appliance Department is certainly sufficient to justify a lighting Company in occasionally giving it the benefit of the manager's personal attention. The routine work will of course be placed in charge of a man who may be called the Appliance Department Manager.

It has been proven that payments of one dollar down and one dollar a month on appliances will make it possible for every consumer to buy. Even people who have ample means will purchase more freely, knowing that they are obtaining the device at the right price and that it is seldom in business history that an article is sold on the installment plan without advancing the cost to the buyer.

These monthly payments will be handled through your collection department by attaching a separate bill to the meter statement, or as explained under the next heading.

The life of the heating elements will line up to the guarantee of any reputable manufacturer, so you are assuming no risk in making the most of this convincing selling point. In this connection it has been found that if the apparatus is treated with ordinary care the heating element will be in use at twice the guaranteed age. This is not a theoretical asser-

* Presented before the C. E. A. Convention.

tion, but is based upon actual experience covering a period of years.

The Ledger Account

Some Central Stations carry the appliance or merchandise account on the same ledger folio with the current, others prefer two separate books.

Where the Loose Leaf System is adopted a smaller and lighter weight ledger sheet for appliances may be used and when placed in the binder it will always be found directly above the ledger sheet upon which the customer's current account appears.

The keeping of separate accounts permits of analysis in order that the true percentage of current and merchandise may be shown.

In billing, some companies prefer issuing a separate bill for appliance installments, attaching it to the meter statement for collection.

Others contend that it should all be included in one bill, for the convenience of both the customer and the Company's bookkeeping department. It has also been noted that the customer is not then likely to make a payment of less than the full amount of the bill.

Employment of Salesmen

Frequently young men working in the Central Station offices show a natural aptitude for salesmanship. Their services would double in value if they were taken from the desks. Men with ability for this work should be seized upon and developed.

College men usually have the personal appearance and mental training that specially qualifies them in selling appliances to the housewife.

Many young college men have taken up this line of work during vacations and have been so impressed with its possibilities that upon leaving school they have again entered the field.

High school boys of the present day can assume a manly attitude that pleases the lady at the door and she will frequently admit him for an appliance demonstration in her home when older men would be refused.

A foundation for the boy's interest in electrical appliances may be laid by donating two or three devices to the school Domestic Science Department.

This gift will redound to your benefit in more ways than one. It adds new interest to the teacher's work, consequently she will be appreciative. The pupils spread the news at home and parents are thus convinced that the day of electrical cooking has arrived.

The Y. M. C. A. employment bureaus sometimes have recent arrivals seeking positions.

There are many good salesmen in stores who are bent on finding an outlet for their ambition. Some of them would be glad to accept an offer from the Central Station for out-of-doors work.

Manufacturing Companies of heating apparatus may also be in a position to suggest the name of an experienced salesman who is open for employment.

Lighting and power companies have found that while an office display of electric appliances brings returns, a house to house canvass is much more effective. These two plans of selling should both be followed to obtain the best results.

In employing a solicitor it is important that he be fitted for the work. He must have a ready smile, be neat in personal appearance, and a man who specially enjoys winning his game.

Good men frequently object to canvassing but this distaste can be overcome if the facts are presented in the right light.

In the first place the lady at the door gives a cheerful greeting to a man who announces that he is employed by a company with which she already has business relations. This at once differentiates him from the ordinary solicitor. Again women are invariably interested in electric appliances as they are handsome, stand for cleanliness, and are time-savers. They represent modern methods, the very latest improvement in housekeeping conveniences.

The possibility is great of a salesman making more than ordinary wages. It is simply a matter of putting in full time and conscientious work.

Obtaining Results

It is inadvisable to send a man out with more than one appliance at a time, but he should have with him cuts and prices on the complete line. After he has studied the literature and sales-talk furnished, his constant hammering on one appliance so familiarizes him with his "stock talk" that while giving it he can be studying his prospect. He will then be ever alert to seize the psychological moment for closing the sale.

Solicitors by occasionally changing the appliance will prevent their work from becoming monotonous and will have an article of fresh interest to show the consumer when the next call is made.

You will find that the demand for coffee percolators, grills, toasters, etc., will be just as great as it has been for irons. Take, for instance, the coffee percolator; coffee is made at least once a day in nearly every household, indicating that every one is a possible buyer.

Furthermore, half the housewives have already expressed their wish that they had a good percolator. The many advantages of the electric pot over all others are so apparent that it doesn't require much time to convince a prospect. The electric iron has paved the way.

Now arises the question of price. We realize that in most cases it is necessary to make a special inducement in order to effect a sale at the door.

It is our opinion that an offer of "easy terms" is all that is required; a lighting company is so situated with reference to its consumer that it can extend credit without assuming any great risk. Ordinarily they have either a cash deposit or references and collectors are in constant touch with consumers.

The merchant is not so fortunately situated, nor can he put all of his profits back into advertising and selling and still come out ahead of the game.

We wish to urge upon lighting companies the desirability of maintaining good terms with the dealers.

There is no question that the dealer has his circle of friends and customers in a community who would prefer dealing with him. A word from him will frequently prevent many from buying and he is prone to "knock" when in competition with the lighting economy.

It has been found that women discuss electrical appliances they have with their friends with great zest. This neighborhood discussion, coupled with liberal advertising, calls of solicitors and co-operation of dealers, will stir up a surprising demand.

Above all, weigh with care the merits of a line of appliances before placing them with consumers. Dissatisfaction kills the demand just as quickly as a meritorious article will build it up. Cheap goods will sell but there is an aftermath that will put your nerves on edge.

Liberal advertising will make heating appliances a household byword. Then salesmen will not have to spend time in convincing a prospect that they are offering a meritorious article. It is working along the lines of least resistance. There is a certain lighting company that has put out 8,000 percolators and only 150 came back.

Compensation

In the employment of salesmen it has been found advis-

able by some companies to place them under a small bond.

The reason for this is that the men collect considerable sums of money, both from those who do not wish to take advantage of the installment plan and from those who make first payments.

It is wise to hold up the application for a bond for at least a week in order to determine if the man is qualified for the position and if he is liable to stick.

The bond is paid for by the company, the charges being small.

If you follow the plan of making a monthly deduction from salaries to cover sick benefits and insurance, include these salesmen; make them feel that they are part of the regular office corps.

Numerous plans of payment for services rendered in selling appliances have been tried out. Some salesmen prefer being paid a liberal monthly salary and a small commission on sales. The advantages in favor of this system are:

Good men frequently hesitate at leaving the positions they have and start work on a commission basis. To them the plan is new and untried.

If a capable man works conscientiously with your consumers you are deriving a benefit other than that received from his direct sales. People may not be prepared to buy at the time they are approached, they may buy later at the company's office or they may close with the next salesman who calls, because of the efforts of the first man.

The fact of someone other than the unwelcome collector calling from your office, meeting the customers with a friendly smile and convincing them, if necessary, of your good will and responsibility as a guarantor, ties those consumers to you with a personal bond that you have not before enjoyed.

So we affirm that if your salesman at the end of the month has not made many sales and throws up his hands, you are not a loser and will eventually derive full benefit from his labor.

Another benefit in the larger monthly salary lies in the fact that men will at least give the position a month's fair trial.

In this, as in any other vocation, experience cannot be developed in a day and first efforts are frequently disheartening.

Under these circumstances, some men, if working on commission solely, will quit, whereas a few weeks' experience would have brought them out on top.

One more reason in favor of this plan is that salesmen will give more careful consideration and attention to orders from the office and will not be so frequently tempted to make misrepresentations in order to land a wavering prospect.

The considerations in favor of the large commission and small salary, or none, appear to be: More aggressive work on the part of some solicitors who set a mark, and the natural automatic adjustment of salaries to correspond with the abilities of the salesmen.

Commission should not be paid until you are fairly certain that sales will stick; one week after delivery should at least elapse before payment is made. Returns, after commissions have been paid, must be deducted from later earnings.

Guard against abuse in taking back appliances. Some customers will use a heater during the spring and on a trivial complaint attempt to turn it in for a fan in the summer. Dealers avoid returns and still hold their customers; you can do likewise.

Don't be discouraged by frequent changes in your selling force. Keep in mind the realization that every appliance you sell will for years to come be earning you that little old fifty cents a month.

It has been estimated by one of the large lighting companies of New York that six months' returns from a lighting contract is a fair expense allowance for securing new residence business.

Assuming that an average residence connection will bring in a revenue of $18 a year, which is low, then $9 would be the cost of obtaining the contract.

Upon that same basis an electric appliance will give a revenue of $6 a year and $3 would be a fair selling cost.

You will also remember that this selling cost on a large number of appliances on your lines is borne by the dealer. Add the profit you make on the sale of an appliance to $3, the amount you would be justified in paying, keeping constantly in mind the fact that this makes for a day-load, and you will realize that you can afford to pay a big salary to a big man.

Don't count the cost when you have your eye on a live salesman or the making of one, nab him on the spot.

Frequent Meetings

Salesmen should frequently be called together for a comparison of ideas and experiences.

If regular meetings are insisted upon it will grow to be a matter of routine to which no objection will be raised.

That interest may be added to these meetings, have your men take turns in going through the form of selling appliances to one of their number who will offer the usual objections. It will sharpen up their wits. At the conclusion of the test invite criticisms.

In starting out new men load them up with literature and salestalks. It is not necessary that they repeat it parrotlike, but it gives a foundation, a starting point, upon which to build. Before they are permitted to go out see to it that they are examined and properly qualified.

If men spend time and thought in preparing for this work they will convince themselves that they have a good article and will not be so easily rebuffed.

If you think it best to first send them out with an experienced man see to it that you select one as in instructor who isn't inclined to "knock." Those who go out with new men should realize that when all of the men employed are doing a good business the department takes on an added importance. They will be more liberally helped with advertising and the manager will be more disposed to increase the commissions.

When Salesmen Grow Stale

The time usually arrives with salesmen when they have the impression that they are past masters in the selling game. If orders are not coming in to your satisfaction these men promptly affirm that the trouble lies either with the appliance or the territory they are covering. As a matter of fact they may be growing stale in their selling methods.

The best plan to disabuse their minds of this impression is to call a series of meetings and invite travelling men or local salesmen, in other lines, to address them.

They will soon discover from these talks that there are many schemes for bringing about a sale that have never occurred to them.

The automobile salesman is always up against the keenest competition and has many a tough nut to crack.

He usually is willing to address these meetings as it gives him an opportunity of advertising the merits of his car with men who are in constant touch with the public.

Have your lighting and power contract men and office force attend these meetings. It will have a tendency to ginger them all up to a better efficiency.

When a salesman has not been successful in his district his failure may be due to a personality that doesn't please the class of people living in that locality. Try him somewhere else and he may do exceptionally well.

Encourage the men in studying literature describing

competing appliances. If an opportunity offers have them examine their construction.

Do not hesitate over having them make frequent calls on the same consumer.

These people are finally impressed by your persistence and continued enthusiasm.

Under present business conditions trained men are displacing those who have but a superficial knowledge of their business.

The science of selling will always afford an interesting study and men who succeed will be greedy for knowledge that they can utilize in their work. Your best men will derive greater pleasure from achievement than they will from the size of their pay check.

A Preliminary Step

If before a salesman is sent into a certain field, advertising matter is mailed to consumers, followed a few days later by a circular letter, it will greatly facilitate the efforts of you representative.

This letter should be sent a day or two before the solicitor calls.

Thousands of dollars are paid out by firms introducing specialties for mailing lists. A large percentage of the names they secure are not even possible purchasers.

The list you have is invaluable for this purpose and should be used to the limit.

Let your letter read something like this:

Dear Madam:

We sent you a few days ago circular matter describing our Electric Coffee Percolator.

We have tested from a practical and mechanical standpoint the various appliances of this character now on the market and unhesitatingly recommend this Percolator as being the mose serviceable and economical coffee pot.

This selection was an important matter with us as we hope to have you on our consumer's list for a number of years to come and we do not want any dissatisfaction to arise because of our recommendation.

One of our salesmen will call upon you shortly for the purpose of demonstrating this device and we ask that you give him a few moments of your time as we are making a special offer that will be well worth your consideration.

Yours very respectfully.

Sales Women

It has been found in some instances that women are more successful than men in selling appliances.

One of the best methods of operation for them is to make telephone appointments in advance. This plan gains immediate entrance to the house.

They having used gas and stove utensils will speak with the conviction that comes from experience when comparing them with electrical appliances.

A Salesman's Incentive

The success or failure of your appliance department will depend largely upon the character of the salesmen you employ. Some good men may be obtained from other lines of employment if you make your offer sufficiently attractive.

Remember that there is a prejudice against house to house canvassing that you must overcome—make your call for salesmen, not solicitors or canvassers. We know of instances where appliance salesmen have drawn as high as $400 in commissions for a month's work, the possibilities are there if you obtain the right man.

If you haven't time to present the offer to the man you have in view as it should be presented, give him a copy of the following letter.

We think it will appeal to youg men who are in the rut and haven't had the nerve to get out and do things; men who are working ten hours a day for a pittance:

To Salesmen

"This letter is addressed more particularly to men who feel that if they had scope for their activity and ambition, they would accomplish things worth doing.

You will agree that the first requirement is forming a connection with a company well capitalized and likely to grow even in advance of the community in which you are living.

Once get your foot on a rung of the ladder and if you are made of the right stuff, you will climb and your objective point will always be worth while.

There is scarcely a department in a lighting company organization where more immediate notice is taken of a live, intelligent, responsible man than in the appliance department.

The reason for this is two-fold. The sale of anything other than electric current by companies of this character is not usual, consequently results are being watched by every one from the manager to the office boy.

Another reason is that, in the past so-called outside men in every branch of business have in many instances proven themselves unreliable.

This puts a premium on the man who is reliable and "makes good," and he will find it the most profitable, agreeable and independent work he has ever performed.

It is a well-known fact that out-of-door work will improve a man's health and his mentality to the point where he will accomplish all that is in him.

We want first to impress upon you the fact that calling upon a lighting company's residence consumers is quite different from the house to house canvassing for subscriptions or silver polish that you may have in mind.

The company's name will be found the open sesame to the homes of their patrons for business purposes and you will find the interest taken in electrical appliances will surprise you.

Remember, too, that we pave the way with literature and letters, so that you will be introduced and expected.

Men in the appliance department have found that after a week's experience, six hours of hard, conscientious work will bring in greater cash returns than men of equal ability are earning, though they have been employed for years in what they considered good positions.

The observing man will obtain unlimited knowledge and entertainment from his work.

He weighs his prospect's character, determines whether he will first have to create a stronger desire or concentrate on quality, or prove economical operation. Frequently the first step is getting on a friendly basis by a way foreign to electric appliances.

A man's wits are kept on keen edge and after a month's work in the field, he will find himself better prepared to cope with any situation in his personal affairs requiring prompt mental decision.

When you are working on a commission basis and a line of action makes a dollar or loses a dollar on the spot, you will analyze your methods as you never have before.

Right here, we want to say a word on salesmanship generally:

It is the key to success in every man's life. The doctor must sell his professional services. Professional ethics may compel him to cover his tracks, but nevertheless his dress, his beard, his manner, his conversation, his social relations are all more or less determined by his idea of what makes the strongest pull for his services. And so with the attorney and even the young man contemplating marriage will find the attractive Miss sought by others and every element of sales-

manship will enter into his courtship though he doesn't realize it.

If, then, one's capabilities in this direction determine his future, why not get into a field where the highest degree of cultivation is possible; where your efforts stand or fall every half hour.

A good specialty salesman is in a position to demand the largest salary paid by business men. Big manufacturers are helpless without them.

The man who engages in this work will quickly discover that a smile will inevitably bring a reflected smile from his prospect and a kindly reception. Having this in mind, the good salesman fights off the feeling of grouchiness until it is foreign to his nature.

The advantage of this training over office or store work will be apparent when you consider that a man entering a store and asking for a particular article is an "easy mark" as compared with the one approached in his own office or home and there induced to purchase an article that he had not before desired.

Don't you see how much more instructive and interesting is the game under those circumstances? Go in with a determination to win; the returns financially will justify it."

Keep in Touch

Always remember that a word of congratulation when justified and a reasonable criticism when deserved, will do more toward holding salesmen than will a raise in salary.

This is particularly applicable to outside men. They are working under high pressure and need to be kept in mental balance.

The appliance manager who keeps in close daily touch with their work will greatly increase the output.

Sales Record

The form appended will be found useful in routing the salesmen in the field. It also supplies a complete record of appliances sold.

These forms should be printed on a lightweight index card of good quality. For convenient use they are filed by district in a cabinet.

If a salesman has occasion to use an alphabetical arrangement he can readily find the name he wants in your permanent records.

If you now have no arbitrary designation for districts a numerical classification will answer, the cards in each district also being numbered consecutively.

The names of the street or streets covered should be written at the tops of the cards and these with the consumers' names and addresses should be typewritten as constant usage on the streets tends toward making them illegible.

Index tabs showing streets or districts will be useful.

These cards are passed out to the salesmen each morning and upon them they enter not only sales made, but by using symbols they may indicate the preference of the prospective customer beneath the appliance wanted. An absolute promise to purchase when the next call is made should be carefully noted.

Care should be exercised in keeping the number of names given to each salesman down to a minimum consistent with thorough work. Salesmen are disposed to pick the easy ones and fail to give the more obstinate prospects the time they should have.

It is a good plan to furnish salesmen with black cloth, stiff back, side open, book cover the size of these cards. By using a heavy paper clip the cards can be secured to the back cover, thus preventing loss or defacement.

When one tenant moves, or another enters, change of name should be made on the cards.

If a number of salesmen are employed they should be kept on the same district. This facilitates delivery and enables the men to meet occasionally during the day for a comparison of notes. By this means, too, a friendly rivalry is fostered.

Office Display

An attractive office display of electrical appliances will augment the sales in a way that will convince you it pays.

Place a table or counter, with steps on it, against a side wall. Cover it with black velveteen and upon this display your articles, being careful about keeping them fresh and bright. Beneath the table place cupboards for reserve stock. Have cords in light sockets ready to attach to the appliances you are showing.

Your display may be made more impressive by adding a wall case with glass doors.

The table "Show" will bring the best selling results, as many visitors are more likely to purchase when they can pick up an article and examine it without calling a salesman.

A neat demonstrating table should also be put in and at the time of month when consumers are calling in the greatest numbers to pay their bills have a girl giving demonstrations of various apparatus. See to it that her selling arguments are just as sound as those used by the men and that she does her work in a pleasing manner. Also secure demonstrating appointments for her with cooking schools and women's clubs.

You will find that this display of appliances in your office will make it much more attractive to visitors and that the department will quickly gain your respect because of its earning capacity.

One method of advertising which results in bringing in business is to print descriptive matter and small cuts of devices on the backs of meter statements. They are certain to find the mark, and are usually kept on file by the consumer.

Newspaper advertising, particularly in the smaller cities, will help in making your demonstration and your soliciting campaign a subject of general comment among housewives. You can obtain from manufacturers cuts illustrating any of their appliances which you desire to feature.

Using a Social Function

This plan, more particularly in small cities, should work out successfully.

Select ladies who have an extensive acquaintance in the neighborhood in which they reside, and induce them to invite as many as possible to attend lectures on electrical appliances, and demonstrations, at their homes.

Let it be distinctly understood that no sales are to be made at the time, nor are prices to be discussed.

This defines the occasion as a social gathering, and the discussion of the electrical branch of Domestic Science will be found an instructive means of entertainment.

The lady at whose house the demonstration is held should be presented with an appliance without charge. This will usually be found sufficient as an inducement for her to make the affair a success in point of attendance.

A twenty-minute talk may be easily prepared, covering the application of electricity as a source of heat for cooking.

The demonstration should be limited to one or two appliances, but the other devices should be so described as to whet the curiosity of those in attendance to the point that they will express a desire to see them. As an example, an interesting exhibition may be given with a chafing dish and a percolator. Some dainty dish may be prepared on the former and coffee may be served from the latter. The idea then would be to describe other appliances in such glowing terms that every woman present would want to see them. This would give an excellent opportunity for other demonstrations.

The way is now opened for appointments at the various homes of those interested. These may be made at the time or later by telephone.

In some instances it might be advisable to promise the

lady in whose house the demonstration was held, a small commission on resulting sales.

The same plan, when applied to churches and social clubs, has proven successful, the inducing commission going to the organization treasury.

Young college men are specially qualified for this class of salesmanship, and they will find it highly congenial work.

Elec-tricklings

Make liberal use of the display cards furnished by manufacturers.

Salesmen should be posted on the relative merits of the various appliances on the market.

A display of appliances on a tea table always attracts attention and emphasizes the coziness of electric cooking.

Selling two appliances with but a single cord justifies a reduction of one dollar. This makes an apparent special price and results in the sale of more appliances.

A salesman without enthusiasm will not serve your purpose. He is like a lamp with a broken filament—appears all right until you try to electrify him. He will never light the way to success.

The Kansas Gas and Electric Company issued an attractive circular illustrating all of the electric appliances they handle.

The headlines read: "What ten cents' worth of electricity will do." Under each article was printed the statement of how long or how many times the appliance could be operated for ten cents.

In order that immediate orders might result, a coupon was attached which upon being presented at the office, was good for fifty cents to apply on the purchase price of any appliance shown.

Electric irons may be sent out on trial without much likelihood of their being injured by thirty day's use. It has been the experience of central stations that not over one out of fifty will be returned.

Hotels and cafes of the better class afford an excellent field for salesmen. There is an opportunity to put over a specially large order and incidentally the placing of appliances in such public places makes effective advertising.

In the morning it delights guests to either prepare toast themselves or to watch a waiter do so at the serving table.

The coffee percolator is an ornament to any table and gives ample assurance that the coffee will be fresh and good.

Evenings the chafing dish adds much to the pleasure of the lunch.

"The Cave," a fashionable restaurant connected with one of the best hotels in New Orleans, has a great number of these appliances in use, and the proprietor is delighted with his venture into the electrical field.

Men who are out on house-wiring campaigns and who are seeking new business are in a position to and will sell many appliances. Point the way and pay them in addition to their regular work, and there will be no question about results.

The Southern California Edison Company, of Los Angeles, Cal., has 80,000 consumers and over 90,000 appliances in use on their lines, which conclusively shows what intelligent effort will accomplish in building a day-load.

The Little Rock Railway & Electric Company installs in the street cars a small receptacle for folders. These folders are devoted principally to well-selected jokes, but the electric iron or percolator talk is present, and passengers with ample time on their hands are certain to read every line.

While making demonstrations at the homes of consumers a handful of pennies will sometimes help in clinching the sale. At the conclusion of the demonstration hand the lady a penny. She will very naturally want to know the reason for such munificence. Simply inform her that the penny will pay for all the electricity used while demonstrating an electric toaster, and that there will be a credit left over to be applied on the cost of a future cooking operation.

Some salesmen have successfully used this penny plan in selling percolators. They carry coffee with them and serve the prospect with as good a cup of coffee as she has ever enjoyed, at a cost of less than one cent.

A number of forms for use in the Appliance Department were appended.

Saanich Line Operating

The Saanich suburban line of the B. C. Electric Railway Company, connecting the city of Victoria with the northern end of the peninsula at Deep Bay, was formally opened by Sir Richard McBride, Premier of the province, on June 18, the inauguration of the line to traffic being celebrated with approximate ceremonies in which a large number of prominent Victoria citizens took part. Trains will run every three hours from the Douglas street terminal, to Deep Bay, the twenty-four-hour system, as is the case in the operation of the C. P. R. trains, being observed. While the service arranged is only a tentative one, in the sense that many improvements are contemplated by the management before it will be brought up to the standard which they hope to establish, it will at once provide transportation facilities which will materially aid in the development of the whole of the Saanich Peninsula.

Electric Interlocking

A hand-hook published by the engineering staff of the General Railway Signal Company of Rochester, N.Y., with an introduction of Wilmer W. Salmon, President and General Manager of this company. The General Railway Signal Company have been pioneers in the manufacture and installation of Electric Interlocking equipment and the present handbook is published to meet the requirements of the many present and prospective users of their dynamic indication electric interlocking. In this handbook it is sought to furnish data that will be useful to all those seeking a true understanding of the dynamic indication principle and to those who are required to prepare bills of material for or to install, operate or maintain the electric interlocking equipment of this company. The handbook is well bound in leather covers, is divided into sections treating the various phases of the subject separately and with a complete index. A number of useful tables are appended.

Personals

Mr. W. Chase Thomson, M.Can.Soc.C.E., has opened an office in the new Birks Building, Montreal, where he will act as consulting engineer, making a specialty of bridges and other steel structures in which work he has had wide experience.

Mr. A. C. Towne has succeeded Mr. C. B. Ellis as manager of the electrical department of the Montreal branch of the Canadian H. W. Johns-Manville Company, Limited. Mr. Towne was formerly foreman of the electrical branch of the C. P. R. Angus shops, and put up the first wire in those buildings.

Mr. Charles B. Ellis has been appointed manager of the Economy Fuse and Manufacturing Company of Canada, Limited, with offices and warehouse in the Herald Building, Montreal. Mr. Ellis until recently was manager of the electrical department of the Canadian H. W. Johns-Manville Company, Montreal, and takes a very active part in electrical affairs in the city. The Economy Fuse and Manufacturing Company are organising branches in the larger cities of the Dominion.

Testing of Telephone and Telegraph Lines*

A Series of Short Articles Based on the Author's Practical Knowledge and Experience— Applicable to Plant of Any Size or to Any Manufacturer's Equipment

By Mr. T. H. Nicholson

The fact that in the regular type of the Wheatstone bridge a relation of values, rather than actual values, is used, is taken advantage of for many special purposes to simplify operations, especially where very accurate measurements are not essential but where speed is desirable. Referring to Fig. 4 it is obvious that if R is made a fixed resistance and a balance obtained by adjusting A and B then the original equation still holds good. Now if provision be made to move point F along A towards C, or along B towards D, the same result will be obtained. This is not possible with the ordinary bridge, because of the few available points of adjustment; but if the A and B arms are constructed with a large number of steps of small and uniform resistances, and means provided to connect point F to any one of these, then the ratio of those on one side of the point to those on the other will be the ratio of the fixed, or R, arm to the unknown resistance. In actual practice however, instead of small coils for A and B, a length of bare wire of uniform and high resistance is stretched between two points over a scale suitably divided. The method of stretching this wire in a space of convenient dimensions, and to give sufficient length, varies with different manufacturers. One method is to stretch it back and forth between two parallel rows of insulated pins and another is to wind it around a drum. In the former case the two ends of the wire correspond with points C and D of Fig. 4, and the circuit is completed with a "slider" or "tapper" taking the place of point F. With the drum method the ends of the wire are also points C and D and the drum is arranged to revolve in screw fashion, with a pitch corresponding to that of the wire winding, and making contact with a brush to take the place of the tapper. In any case the scale is divided off

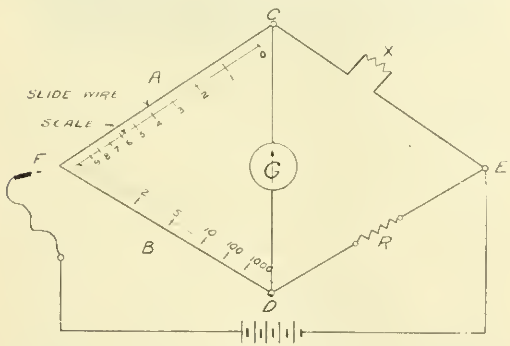


Fig. 5—Slide wire bridge.

to show the ratio between the A and B sections of the wire at any particular point.

Fig. 5 shows in conventional form the slide wire bridge, and also shows the method of dividing the scale. The fixed resistance R may be of any value, but should, if possible, be of round numbers, so that it is easily multiplied or divided by the slide wire ratio. Where a wide range of resistances have to be measured it may be in the form of an adjustable resistance, so that it can be made to coincide with the unknown resistance and more accurate results thus obtained.

A convenient range is obtained from a resistance box containing coils of 1, 10, 100 and 1000 ohms. A little study will show that when the pointer F is at the centre point of the slide wire the two parts on each side of it are equal, and the unknown resistance therefore equal to R. If a balance is obtained at a point nearer C, then the part from that point to C will bear the same relation to the remainder as the unknown does to R, that is, assuming this point to be at .1, this indicates that, when the wire is divided at this point, A is 1/10 of B, and X is 1/10 of R. Similarly if a balance is obtained on the other side of centre point, then the unknown

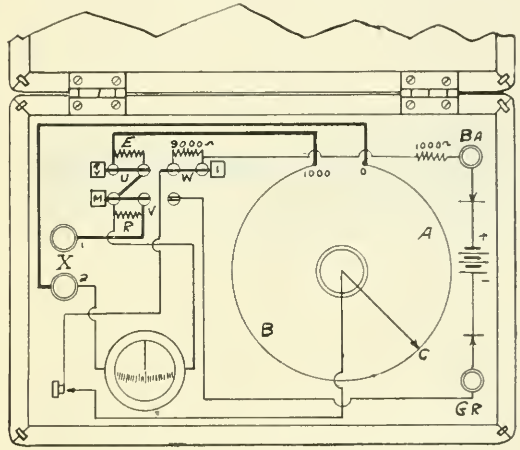


Fig. 6—Circular type slide wire bridge.

will be as much greater in proportion to R as B is to A, or if the balance point is at 2, that it is twice as great as R.

Fig. 6 shows the circuits of a well-known testing set of the slide wire type. In this instrument the usual wire is, by special construction, mounted on a ring of comparatively small diameter, and a sliding contact made to brush over the convolutions. This contact is controlled by a handle to which is attached a pointer to indicate the ratios on a circular scale; as shown on the circuit, switches are provided to easily arrange the bridge for either metallic or loop measurements and to permit the use of outside battery when necessary.

(To be continued)

1912 Telephone Extensions in Saskatchewan

Very considerable extension was made to the Saskatchewan Government system during the year ended February 28, 1912, according to a report just issued. Including the purchase of three private exchanges and cost of new construction along with the cost of maintenance and operation, there was a gross expenditure of $1,526,755.95 during the year. The gross income amounted to $392,393.17. During the year construction has been done as follows:—new toll offices 46; new exchanges 34; pole miles, long distance 516.22; wire miles, long distance, 3,766.8. Service was extended to 4,288 new subscribers during the year, making a total of 9,850 subscribers now being served. These with the 6,148 rural subscribers served by the rural systems built since the province took possession of the field makes a total of 10,534

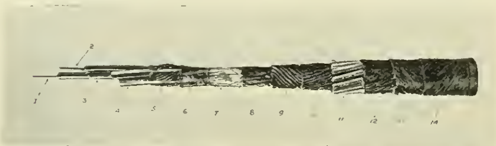
subscribers served through the provincial system. Within the year 109 companies have been organized and incorporated representing 2,140¼ miles of system serving 2,333 subscribers. This makes a total during the four years of 251 companies incorporated with 5.621¼ miles of line and 5,923 subscribers served.

The telephone situation in Saskatchewan at the above mentioned date showed 251 rural telephone companies, 22 independent companies, 5 municipal telephone systems in addition to the government system.

New Telephone Cable Across the Gulf of Georgia

A submarine telephone cable possessing several interesting features has recently been laid in the Gulf of Georgia by the British Columbia Telephone Company in connection with the development of traffic between Vancouver and Victoria and all other points on Vancouver Island.

The cable lies between Pt. Grey on the mainland, and Newcastle Island off Nanaimo, the length being 28.3 nautical miles. The shore ends terminate in cable huts where connection is made with the land lines to Vancouver and Nanaimo, these being carried on the island end by means of a special system of high poles across the narrow channel from Newcastle Island.



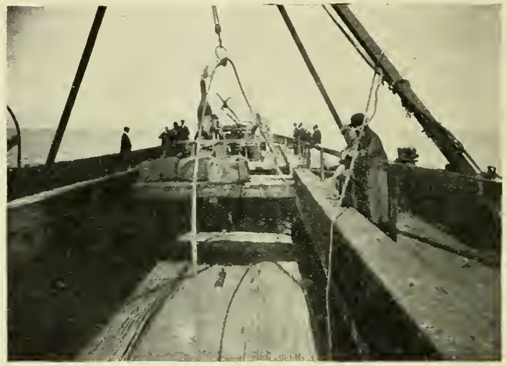
Section of cable stripped to show component parts.

Protection from lightning is afforded by dischargers of the Lodge Muirhead type consisting of a graduated system of spark gaps alternating with impedance coils between the land lines and the cable. The sparking points are mounted radially round the edge of a metal disc which is grounded. The apparatus is mounted in sealed iron cases, the leads entering through air-tight glands.

The cable has four conductors of the continuously loaded "Krarup" type. Each conductor consists of a central wire of pure annealed copper surrounded by twelve smaller wires, the composite conductor having a diameter of 0.139 inches and a weight of 300 pounds per nautical mile. A single soft iron wire of special manufacture, diameter 0.12, is closely and evenly wound on the conductor making 70 turns per inch. This provides for loading a continuously distributed inductance which adds so materially to the efficiency of the cable for telephone purposes.

Cable as it lay in specially constructed steel tank on board steamer that brought it from England. Tank 25 ft. in diameter. Cable 12 ft. deep in tank.

The loaded conductor is covered with three concentric coatings of best gutta percha having a total weight of 300 pounds per nautical mile. Four of these cores are stranded round a centre of yarn, the spaces between the cores being similarly fitted. A layer of brass tape is provided to prevent the possibility of teredos or other submarine borers from attacking the gutta percha. A heavy serving of tarred yarn provides a bedding for the fifteen heavy galvanized steel armoring wires each of which is separately served with tarred yarn. Two layers of prepared yarn and two coats of preservative compound complete the construction.



During cable-laying operations—nearing the end.

The cable has a diameter of nearly two inches and weighs about 8 tons per nautical mile. At a standard temperature of 75 degrees Fahrenheit the electrical constants per core per nautical mile are:—conductor resistance, 4 ohms; electrostatic capacity, 0.35 microfads; and dielectric resistance, 250 megohms after one minute electrification. The attenuation constant is about 0.019 per nautical mile of cable at a frequency of 800 cycles per second.

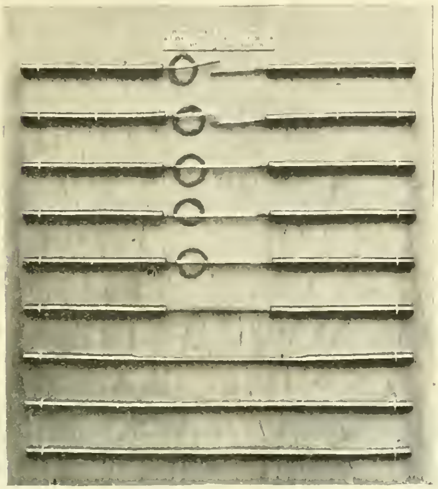
Compared with the British Standard Cable which is a pair of conductors having a resistance of 88 ohms, a mutual capacity of 0.054 microfarads and an attenuation constant of .103 per statute mile, this loaded cable is six and a quarter times as good. If compared with the American Standard Cable which has a capacity of .06 microfarads per mile the result is correspondingly better. Actual speech transmission tests taken upon completion of manufacture and also after laying give a ratio of five and a half times which is a very close confirmation when the losses by reflection and the personal errors of observation incidental to these tests are considered. The four conductors provide two highly efficient physical circuits, a third circuit being phantomed for local traffic without appreciable crosstalk.

The cable was manufactured by Henley's Telegraph Works Company of London, England, and shipped to the Pacific Coast in a sealed iron tank specially built into a freight steamer as shown in one of the accompanying photographs.

The successful laying of the cable marks an era in submarine telephony as it is laid in deeper water than any other loaded cable and is the longest of its type. The "Anglo-Belgian" Cable although considerably longer is in shallow

water and is coil-loaded, a type of construction that was not considered safe for the deep waters of the Gulf of Georgia.

A section of the telephone cable used between Vancouver Island and the mainland, stripped to show its component parts, is shown in Fig. 1. Its composition is as follows,—(1) solid copper core of the conductor; (2) composition copper conductor, including the twelve small gauge copper wires which are wrapped around No. 1; (3) what is know as the wire lapping, being a fine gauge soft iron wire continuously wound around the copper, and constituting the loading feature; (4) composition core, including the gutta percha insulation, of which there are four; (5) jute worming which is laid between the conductors to form a solid and cylindrical core of the four conductors; (6) saturated tape to bind the conductors and jute worming; (7) continuously wound brass tape to prevent teredos getting into the cores; (8) another saturated tape winding; (9 and 10) jute servings to form a



Specimens showing successive stages of a joint in the core of a continuously loaded cable, with gutta percha insulation.

cushion for the armor wires; (11) armor wires, fifteen in number, and each 3-16 of an inch in diameter, which are wound spirally; (12) jute worming which affords a cushion protection to the armor wires, and is laid between the turns of the wires; it also rounds out the form of the cable; (13 and 14) jute servings, wrapped in reverse directions to hold on the worming beneath and to complete the cylindrical form of the cable.

New Cable to Hong Kong

The first section of the new submarine telegraph cable from Europe to Hong Kong has been laid and connected with shore stations. This section is that between Colombo, Ceylon, and Penang, in the Malay States. The sections of the cable are Suez to Aden, Aden to Colombo, Colombo to Penang, Penang to Singapore, and Singapore to Hong Kong. No new section from Suez to England or the Continent is considered necessary. The next section to be undertaken is that between Penang and Singapore and the one thereafter between Singapore and Hong Kong. The last section to be laid will be the one between Aden and Colombo. This will not be undertaken until after the monsoon, the strong seasonal wind in the Indian Ocean which generally starts in June and lasts well toward September and which raises an ugly sea.

The Maritime Provinces

The Corporation of Dalhousie have started the installation of an electric power plant for supplying the town with light and power. The plant will consist of one 3-phase, 60-cycle, 75 kw., 2200 volt generator with exciter and switchboard; one series street lighting equipment; one 125 B.h.p. horizontal 2-cylinder gas engine; two 150 h.p. gas producers; also one motor driven turbine pump of 600 gals. capacity. The electrical equipment is being supplied by the Canadian General Electric Company. The engine, producers, piping and motor driven pump are being supplied by the Canadian Allis-Chalmers, Limited. Chipman and Power, Toronto, are the consulting engineers.

Grand Falls, N.B.

The Corporation of Grand Falls will shortly call for tenders covering sub-station equipment and pole line supplies for the purpose of supplying their town with a light and power service. Current will be obtained from the Maine and New Brunswick Power Company. An electric motor driven pumping plant is at present being installed in this town by the Canadian Allis-Chalmers, Limited.

Shediac, N.B.

The Corporation of Shediac are changing the method of driving their pumping plant. At present a gasoline engine is used, but instead of this there will be installed a motor driven turbine pump. Contract for this outfit together with necessary piping and valves has been awarded the Canadian Allis-Chalmers, Limited.

Halifax, N.S.

The Foundry Department of the Nova Scotia Car Company was totally destroyed by fire recently. This department will be rebuilt at once and equipped throughout with electric motor drive.

Hillis and Sons are installing an electric power plant in their foundries at Halifax. A number of motors of various sizes will be used. A noticeable feature in connection with this installation is the fact that the generator will be driven by a gas engine, the gas for same being furnished by the Halifax Tramway Company. Contract for the entire equipment has been placed with the Canadian General Electric Company.

Amherst, N.S.

The Canada Electric Company met with a serious loss during the month of June, when their auxiliary power plant in Amherst town was totally destroyed by fire. The losses include series street lighting equipment, several generators and transformers, while the steam equipment was quite badly damaged.

The Amherst Piano Company, Limited, are installing electric motor drives in their new factory. Motors will be direct connected to tools and current will be furnished by the Canada Electric Company.

Lawrencetown, N.S.

The Corporation of Lawrencetown are installing a complete lighting plant in their town. A 35 kw., 3-phase, 2200 volt generator will be used. The plant will be in operation about September 1st.

St. John, N.B.

The E. Partington Pulp and Paper Company are making a number of changes in their electrical equipment. New motors and controllers are being installed and the wiring and switchboard are being remodelled.

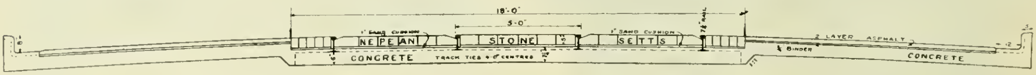
Charlottetown, P. E. I.

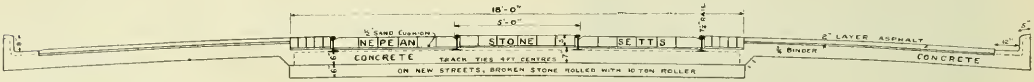
The Charlottetown Light & Power Company are making a number of changes in their power plant. A second gas producer and engine is being installed also a quantity of electrical machinery. The frequency of the present plant is 133-cycles, but the new equipment will be 60-cycles. When the changes are completed a day service will be started.

Electric Railways

Track Construction in Hull, Que.

The two accompanying drawings are illustrative of the paving construction work of the Hull Electric Company, the upper representing the roadway at present in use and the lower figure the type of construction this company proposes adopting for future work. The Hull Electric operate both city and interurban lines but the interurban track construction does not vary from standard steam traction. They have about one mile of paved double-track street and it is proposed to pave another mile during the coming summer. It will be noted that Nepean sandstone blocks are used for paving. In order to make a flangeway with Nepean sandstone blocks, the corners of the blocks are chipped off. This makes a very uneven flange-way which tends to become filled with mud in the summer and ice in the winter. The plan will, therefore, be followed in future of lowering the blocks three-quarters of an inch below the head of the rails so that the size of the cutoff of the corner of the blocks is much reduced, also during the winter a coating of one-half to three-quarters of an inch of hard ice or snow provides a good roadway. During the summer there is also less danger to vehicle traffic as wheels can bind only on one side of the track—the other side being practically clear. The advantage of having the blocks crowned between the rails, or level with the rails at the same height, is not very great and there is the disadvantage that during the winter this portion of the roadway is swept clean by the snow sweepers.





Mr. G. Gordon Gale is general superintendent of the Hull Electric Company.

Gas-Electric Cars

The London (Eng.) County Council have recently placed in operation some three miles of line on which the cars are operated by gas-electric equipment. The decision to use this type of car resulted from objection to the trolley system and the prohibitive cost of the alternative conduit system.

A 40 horse-power gasoline engine together with motors, generator, controllers, etc., were manufactured by the W. A. Stevens, Limited, at their Maidstone works. There are two motors, 20 horse-power each, one for each axle and geared to the axle by a 6 to 1 reduction. Either of the motors is capable of operating the car on the level road. The generator is of the shunt-wound, inter-pole type, 350 volts. The engine operates at 700 to 1000 r.p.m.

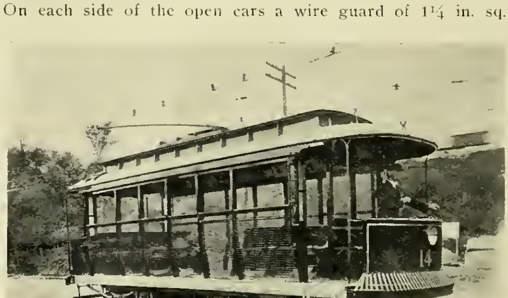
Arrangements have been made in the wiring construction by which it is possible to operate the motors from either an overhead or a conduit supply as an alternative to the contained generator, so that the cars can be operated either as purely electric or as gas-electric.

The cars are double-deck, 27 ft. in length over all. The engine is placed on the front platform and the generator just to the rear of the engine and extending up under the front end of one of the longitudinal seats.

It is reported that the experiment promises to be very successful and that in all probability the three original trial cars will be supplemented by others.

"One-Man" Cars

The Sherbrooke Railway & Power Company have been operating in Sherbrooke some "one-man" cars. These cars were not specially built but were made from rolling stock in hand and have been found very satisfactory. Changing over the open cars was a little more difficult than the closed cars. On each side of the open cars a wire guard of 1¼ in. sq. mesh, No. 10 wire, was placed. One entrance and exit was left on each end of the car and a door way was cut in each bulk head. Being a double ended car it was necessary to



Sherbrooke one-man cars.

provide a folding gate at each end and also a folding step. On reaching the terminus the rear gate is closed and locked so that passengers both board and alight from the car at the front end. With these cars the stops are made on the near side of the streets.

The seating arrangements were altered to make room for an aisle from the bulkhead entrance to the centre of the car. This reduced the seating capacity somewhat but as these cars are seldom crowded on the lines on which they are operated the reduced seating capacity is not important. Standing room was, of course, increased.

These cars have been the means of reducing platform expense considerably and there has been no accident of any kind to date. The schedule speed on these lines is 8 miles per hour which the one-man cars have been able to maintain.

A New Trolley Catcher

The Ohio Brass Company are now offering for sale the new trolley catcher shown in the accompanying illustrations. Fig. 2 shows the principal parts of the operating mechanism. Three dogs, mounted on the back of the reel are thrown outward by centrifugal force when the trolley wheel jumps. One dog rides over the guide, A-B, and engages the stop at B. Under normal conditions, these dogs are held in toward the centre by rugged coiled springs which are enamelled to prevent rusting. In operation the coiled springs are only slightly extended, insuring long life. The main operating spring is enclosed in the extreme back part of the case. All parts are made sufficiently rugged to withstand the abuse which such a device usually gets in service. The case is made of malleable iron, enamelled. A large opening is provided at the bottom to drain off moisture. A separate base casting is bolted directly to the car dash and the catcher can be quickly inserted in the base and held in place by a

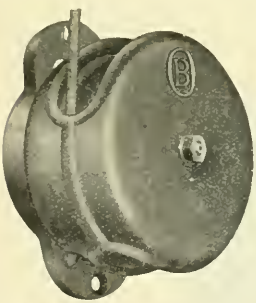


Fig. 1—O-B Trolley Catcher

Fig. 2—Pantom View

spring operated catch. For double end operation, a base is installed on each end of the car and one catcher used.

One of the aims of the designers was to eliminate stepping up or climbing of the trolley pole after the rebound which follows the sudden stopping of a flying pole. This was accomplished by means of the guide, A-B, Fig. 2. The dog which engages the stop at B rides over this guide and cannot be pulled back toward the centre by its spring until the rope has been wound in sufficiently to allow the dog to travel backward on the guide to the point A. Exhaustive service tests proved that the rebound will never be sufficient to cause this to happen. In other words, when the trolley wheel jumps, the catcher catches the pole quickly and holds it when caught. Should the trolley pole be thrown downward upon striking a cross span wire the locking dog will become disengaged and the catcher will "reoperate" and another dog will become engaged with stop B, and the pole will then be held at approximately the lowest point to which it rebounds. The manufacturers offer to furnish samples of the new catcher to proper parties for free service demonstration.

Train Operation in City Service

The Public Service Railway Commission of New Jersey has recently been conducting a series of tests for the purpose of determining whether the operation of two-car trains in city service is practicable or desirable and the results have been published. In Newark, where the tests were made, rush hour traffic becomes so conjested as to prevent the operation of a sufficient number of cars to meet the requirements. The cars used were 46 ft. 4 in. in length with seating capacity of 44 and a total weight of 48,700 lbs. each. Each car was equipped with four motors and were of the double-end prepayment type equipped with hand operated doors on all platforms.

Comparative tests were made for a number of lines with single cars, two-car units, and a motor with trailer. The results in general go to show that the two-car train can be operated throughout the route on the same schedule as the single cars and much more satisfactorily than the motor and trailer.

At conjested corners an observation showed, as an example, that two single cars crossing one after the other required on the average 27.1 seconds, as compared with 20 seconds for the train to pass the same corner.

Commenting on the results obtained in these tests the Electric Railway Journal, having made a careful study of the report, has this to say:—

"The results show that, aside from any question of operating cost, the use of trains is entirely practicable in congested city service such as obtains in Newark. That is to say, the tests demonstrated that the riding public accepted the arrangement at once without objection, and no difficulties were experienced through interference of the long two-car units with vehicular traffic. The observations as taken indicate that the train carrying a large number of passengers makes a greater number of stops per trip than a single car. For a given total number of passengers the number of stops is practically the same whether the load is carried by one car or two. This might be expected, as people will board and alight at the same points regardless of the method by which they are transported. The rate of increase in the number of stops is, however, by no means directly proportional to the number of passengers. Instead, it falls off rapidly as the loads become heavy. In other words the number of stops per trip tends to become constant or independent of the number of passengers provided the total number carried is sufficiently great. On none of the test lines in Newark is this point reached within the capacity of the two-car train, but the tendency was so strongly marked when both cars of the train were comfortably filled that the train made only about one more stop per mile than each car would have made had they been run singly.

The loading time per passenger will be found to be approximately the same on the train and on the single car, indicating that the time lost through the transmission of bell signals, through the unequal distribution of passengers between the two cars and through the necessity for the single exit of the rear car was just about offset by the fact that the train provided two entrances for the total number of passengers boarding as against the single entrance of the single car.

It is, however, a fact except on two of the lines tested, that both the public and train crews were unfamiliar with train operation. This, it is believed, influenced adversely the running time of the trains as compared with single cars.

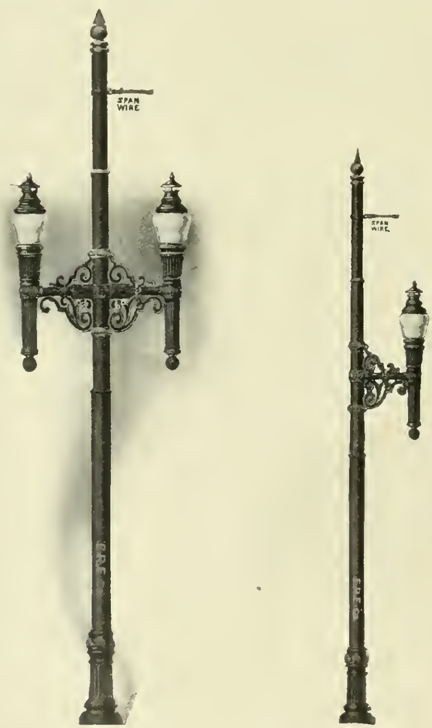
Based upon equivalent passenger loads the observations show that the use of trailers causes a serious slowing down of schedule speeds—much more than enough, in fact, to offset the inherent savings. This is undoubtedly due to the fact that the four 40-50-h.p. motors geared 18.66 were not sufficient to haul a trailer weighing 32,800 lbs. when both cars in the train were heavily loaded."

Illumination

Combination Trolley and Light Poles

The illustrations herewith represent types of combination trolley and electric light poles recently supplied by the Electric Railway Equipment Company. The single light pole is in use in Edmonton and the double light type is now being installed in the city of Niagara Falls.

Both single and double type brackets have met with approval, on account of provision having been made in the body of the bracket for mounting positive cut-out in same. In



Combination trolley and electric light poles.

placing cut-out at this point it is not necessary to slot tubular pole at groundline, which has a tendency to weaken the pole at point of greatest strain. In order that cut-out could be operated quickly and without the necessity of using a ladder to reach it, a small chain attached to the cut-out has been provided. By using a small hooked rod, the operator can stand on the sidewalk and cut lamp in or out of circuit. The chain is carefully insulated from all current carrying parts and there is no possibility of leakage at this point.

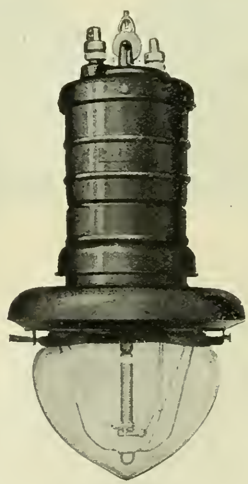
The Niagara Falls order consists of 112 trolley poles which will be placed 70 ft. apart and two lights mounted on each.

The type of lamp used on all these poles is the General Electric magnetite arc. These will be placed, in the Niagara Falls installation, so that one extends over the roadway and the other over the sidewalk.

Large Areas and Exterior Illumination

There is no doubt that the tungsten lamp since its advent has affected to a certain extent the sale of enclosed arc lamps. At the same time there are numerous cases where conditions require an intensely brilliant light over a large area and there the enclosed arc is ideal. Such conditions are frequently found in car shops, locomotive works, foundries, cement works, glass factories, freight yards, wharf lighting, etc. The flame arc lamp is particularly adaptable for this class of service and among the recent developments of this class of lamp, attention is drawn to the C.G.E. type "W," flame arc lamp, shown in the accompanying cut.

Until recently the chief characteristic of the various types of flame lamps seen on the market was, in most cases, length



C.G.E. flame lamp.

in inches rather than length of life. A notable departure has been made in the C.G.E. type "W" flame lamp, inasmuch, as the length over all is only 32 inches. The life per trim is 100 to 120 hours, and then the only thing required is the renewing of one electrode. This last speaks well on the question of maintenance. The mechanism follows closely the general design of the standard enclosed carbon arc lamp,

which makes the lamp easy to operate and avoids a multiplicity of parts. The type "W" lamps are furnished in either a.c. or d.c. multiple, also a.c. series.

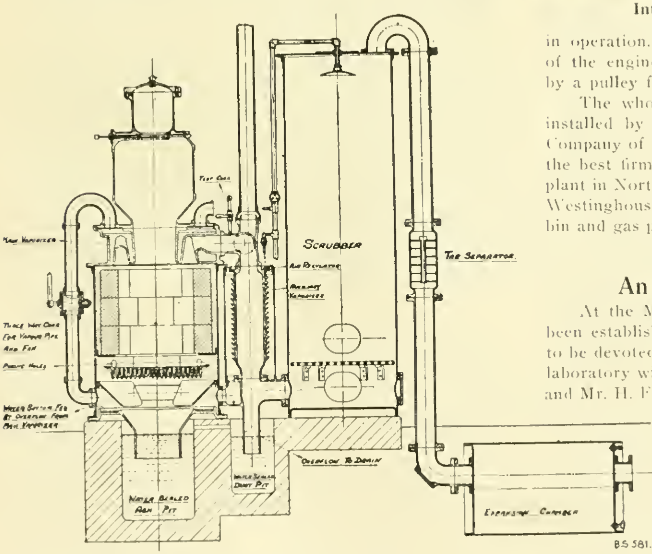
Rapid City Electric Light Plant

By Mr. Thomas Town*

The electric light plant at Rapid City, Man., which was set in operation on the fourth of March, 1913, has proved itself to be of great benefit to the town. Many of the public buildings that had lately been fitted with some of the best gasoline systems have had them replaced by electric light and the gasoline street lamps which have only been in use a short time have been replaced by forty 100 watt tungsten lamps, which have made a vast improvement in the appearance and the lighting of the town. The photo reproduced herewith shows the entire engine-room. The engine is a 50 B.h.p. gas-engine of the throttle governing type which furnishes the power to generate the electricity.

The current is sold at the rate of 20 cents per kw. hour with a minimum charge of $1 per month. The generator is a 3-phase, thirty kw., sixty cycle, 2300 volt unit. This generator is belted to a Ruston-Proctor suction gas engine, which is fed with coal gas supplied by the producer shown in diagram herewith. The cross-section explains the process by which the engine is fed with gas from the producer. The gas passes up through the coal in the producer, in through a coke scrubber, up through this, where the gas is cooled by the water passing through the filtrate, and is also purified; then into an expansion tank and from thence to the cylinder of the engine.

The gas-producer after being filled up with coal will run



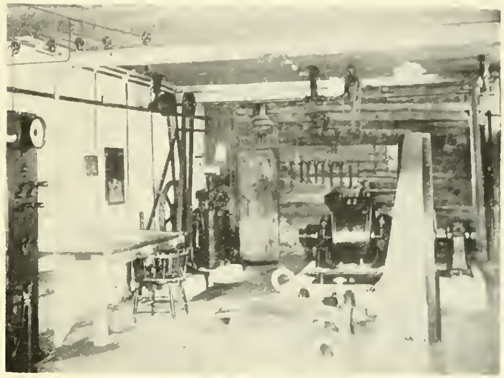
Section through suction gas producer.

from four to six hours without attention. The consumption of coal is at the rate of ¾ lbs. per horse-power, per hour, at full load. The cost of running the plant for 10 hours, with coal at $8 per ton, and oil at 70 cts. per gallon, amounts to $1.14. The results given below are those made by the writer on a ten-hour test, running at half load (15 kw.).

Coal consumption, 250 lbs.	$1.00
Cylinder oil, at 70 cts. per gal., 1 pt.	.09
Ordinary lub. oil, at 30 cts. per gal., 1¼ pt.	.05
Total	$1.14

*Resident Engineer, Rapid City.

From fifteen to twenty minutes is taken in starting the engine. The producer is first made to work freely by the use of a hand blower, then the air of 160 lbs. to the square inch from the compressed air tank is let into the cylinder causing it to start the operation of the engine and keep it going until the engine begins to draw gas from the producer, which if air is shut off will fill the cylinder at each stroke and fire, the same as in any ordinary gas engine. The fire in the producer is kept burning by the suction of the engine after it is set



Interior power house, Rapid City, Man.

in operation. The compressed air required for the starting of the engine is pumped into the tank directly on starting by a pulley from the engine.

The whole plant including the electrical apparatus was installed by the British Canadian Engineering and Supply Company of Winnipeg. This company promises to be one of the best firms to install an effectual and economical electric plant in North America. The electrical equipments are of the Westinghouse make. The whole plant, including the coal bin and gas producing room, occupies a space of 15 x 56 ft.

An Electrical Research Laboratory

At the Massachusetts Institute of Technology there has been established an Electrical Research Laboratory which is to be devoted to research and engineering investigation. The laboratory will be in charge of Dr. Harold Pender as director and Mr. H. E. Thomson as secretary and assistant to the director. Large sums of money have been donated for the up-keep of the laboratory, among the many liberal donors being the American Telephone and Telegraph Company. The problems which it is proposed to take up during the present summer have reference to the clearness of speech as heard through the telephone and to the transmission of alternating current in wires. The first will be an investigation of the effect of phase relation of harmonics in sound waves while the second will be a study of "skin effect" a phenomenon which causes a greater resistance of conductors in alternating than in direct current.

The laboratory will be open the year round and will be in charge at all times of men specially trained in research work. It is the intention to conduct the laboratory entirely along business principles.

The Dealer and Contractor

Costs and Efficiency

By Mr. P. L Proctor*

The subject I have taken for my address is one which you are more or less familiar with, but it is my purpose to explain to you details from an accountant's view. In the time at my disposal, however, I am constrained to limit my views to a lucid summarized explanation of the principles involved, and to eliminate elaboration, which would tend to confuse, and therefore defeat my purpose. I shall endeavor also to confine my theories so as to make them applicable specifically to the needs of the electrical contractor, instead of speaking in generalities. It is well to forget, however, at this time that "the electrical contractor's business is different," and for those who might have the tendency to follow the lines of least resistance, I will say that the principles of costs and efficiency remain unchanged, no matter to what business they are applied. The details change, but the principles remain the same.

The principles of costs as related to the electrical contractor, or any other contractor, are: Material, time, direct expense, and indirect expense. The total of these, plus profit, is the amount a contractor must estimate in order to assure himself of his legitimate profit.

In order to arrive at a complete understanding of one's business, one must introduce a scheme of accounts for ascertaining and recording the cost of production; locate all weak places and so detect waste of material, efficient workmanship and management: indicate the expediency of underbidding a competitor by comparing the cost of production with his bid; establish a standard cost on certain jobs; expedite the framing of estimates to prevent loss by making low quotations or unnecessary high ones, which will permit a competitor to underbid; regulate bidding price according to cost when conditions of supply and demand permit. These features must necessarily be embraced in one's cost system in order that it should be beneficial.

Now let us examine such a scheme to see in what way it would benefit you:

1. Where external conditions permit you will be able to adjust bidding price on the basis of costs.

Many a business man, or, I should say, self-styled business man, especially a debutant, feels that he is ruining his business by not grasping every job that comes along. He never stops to consider where his profit is going to be realized, but the sight of a few dollars, or the anticipation, goes to his head. Business conducted in this manner results in the inevitable transfer to the "has-been" list. The unbusinesslike principles of this one man do not only affect him as an individual, but they affect the whole trade as a body. Profit can be made on all work, but if one contractor makes a practice of underbidding, the consequences are that other contractors must patiently wait until the bankruptcy law begins to stretch out its arms for him. If "John Smith" makes an estimate on a job which you know you cannot compete with, you had better let him take it. Either he will go out of business, or your own business needs rigid investigation.

2. It automatically locates weak places and points out excessive cost.

A feature which is indispensable. There are weak places in every business, and the only way to eliminate these weak points is by first assuring yourself in what department they prevail and in what unit of that department.

3. It furnishes a basis of comparing costs of various elements at different periods of time, indicating excessive increase of cost or decrease in output.

Knowledge of one's business is attained by comparison. The fact that one has lost money on an estimate, but made money on a prior duplicate of it, is sufficient grounds for an investigation. The investigation must be a comparative one. The material used on the subsequent estimate may have been more expensive, the labor employed may not be as efficient, the management may be at fault, but by the introduction of a comparative cost scheme these elements would be obvious before an estimate is made and not when it is too late.

4. Shows the exact point where attention should be focused.

5. Where external conditions fix estimates you will know exact cost of production and be able to secure advantageous contracts which may otherwise go to a competitor.

It is often necessary for a contractor to reduce his estimate down to the minimum on account of external conditions over which he has no control. It is also necessary—or is considered business policy—for a contractor to reduce his estimate practically to cost of production in order to become acquainted with various architects with the idea that it may in some future time secure for him advantageous contracts. It is essential at such a time for him to know where the line of danger lies, and to know definitely his cost of production.

6. It determines the earning capacity of individuals, departments, branches, or entire organization.

By the old methods of accounting it was possible only to determine at stock taking the amount of profit or loss of the entire organization. Competition makes it necessary for the business man of to-day to go further than this. The public designates the price for a certain class of work, and this has forced the business man to look elsewhere for profit. The only available place is the cost of production. It is essential then that he know the relative earning capacity of his men as individuals or the departments of his business.

7. It indicates the expediency of underbidding any competitor.

I have before mentioned that the contractor must know where to draw the line in underbidding, and not rush headlong into any contract. Money has strong hypnotic powers, and unless a business man uses his discretion, he is gradually drawn in to the maelstrom of failure by it. A man who has no system to his business usually is also devoid of discretion.

8. It furnishes a basis of protection from undue expense or loss from any source.

This is again brought about by comparison. "Undue expense" may be inefficiency in workmen, careless work,

* Manager the Pacific Audit Company.

which necessitates its being done over again. This may be traced to the foreman, who has urged too much speed. This may again be traced to the executive who has given such instructions to the foreman. Low estimates often make it necessary for an executive to urge his men to better speed in order to avert a loss which he alone is responsible for. It will be seen that it is possible to trace the trouble to its foundation, therefore overcoming the most difficult obstacle in the way of eliminating it.

9. It shows how and when to reduce unnecessary fixed charges, such as time, material, men, records, interruptions, overtime, handling etc.

In order to facilitate arriving at the costs of any job particular attention should be paid to the manner of recording estimates. An estimate should be divided into departments in exactly the same manner that the cost records record the progress of a job by departments. Each job should have its various departments, as follows:

Floor No. 1—

Wire, plus time, plus direct expense, plus indirect expense equals cost of wiring floor No. 1.

Pipe, plus time, plus direct expense, plus indirect expense equals cost of piping floor No. 1.

It will be readily seen that were estimates to be kept on file in this detailed manner, and the cost records kept to conform to it, the executive would soon locate his weak points in making estimates, and by careful examination of each day's work he would readily see whether or not the estimate in any particular unit and the profits anticipated on it were going to be realized. You will readily agree with me, I think, that such information is valuable, for it gives a reliable basis of argument should the contractor find it necessary to urge his men to "speed up" in order to break even on any particular unit of the work.

The distribution of indirect expense or burden has become the subject of much discussion and debate by many cost experts. Many theories have been advanced from time to time by some of our leading production engineers and cost accountants as to the distribution of indirect expense, but it is as much open to discussion at the present time as it ever was.

At this time we are only interested in the method that best fits the requirements of the contractor, and after much thought I have come to the conclusion that the distribution of burden by the time plan is the one that is more adaptable to his needs. A summarized explanation of this method is: That every productive man in the employ of a company must bear his pro rata of indirect expense of that company. We will take an hypothetical instance:

A Typical Case

You are called upon to make an estimate on a job. Your overhead expense or burden amounts to $12 per day. There are 12 productive men in your employ, therefore each man will bear $1 overhead expense per day. Your estimate will read as follows:

Material	$25.00
Time, 1 man 1½ days at $4 00 per day	6 00
Overhead expense, 1 man 1½ days at $1.00 per day	1.50
Cost of production	32.50
Profit, 25 per cent.	8.12
Amount of estimate	40.62

You will see by this method that the overhead expense practically adjusts itself automatically to a fair amount per productive man. A large increase in productive men generally means a proportionate increase in unproductive men, and, on the other hand, a reduction in the productive force means a proportionate reduction in the unproductive force. At the same time there are certain fixed charges that a reduction in the productive force would not affect, such as rent, light, heat, office expense, etc., and in this case the executive must use due discretion, and must by careful examination ascertain where he can reduce his overhead cost, so as to bring it down to a standard whereby he can render satisfactory estimates and still assure himself of profit.

A cost system which comprises the information I have just referred to is the first step toward efficient management.

To build up a successful business one must not only know the trade or profession in which he has started, but he must be prepared to meet his competitors and start on a level which it has taken them years to attain. In order to do this he must not only familiarize himself with the principles of costs, but he must, each day, watch his business with an eye which has keen analytic powers. Business is a living, breathing, moving being which has an anatomy peculiar to itself, but which can nevertheless be analyzed in its every function. It is the duty of a manager of any business to grasp and interpret his business conditions by units.

I am sorry to say that bookkeeping is only tolerated by many men. It is charged up as a loss and the expression, "if I could only cut down my office force," crude as it may seem to many of us, is by no means uncommon. This class reminds me of an Egyptian mummy. A mummy's only asset is its age, and the only emotion it inspires is one of wonderment that it has lasted.

I will tell you that 75 per cent. of business failures were mummified businesses. If they had been galvanized into new life before it was too late they would be still doing business on a sound basis.

Records Are Invaluable

I have remarked that account keeping was only tolerated and I will venture to say that 50 per cent. of the business men in this country do not use their records enough to become acquainted with the invaluable information they possess. Account keeping, for prudence sake, is worse than no account keeping, for the man who keeps no accounts obtains the same information, which is nil, as the man who keeps accounts for prudence sake, and at less cost. If you are going to keep accounts and are employing an office force to keep them for you, do not let this department become a loss to your business. If it be used in the manner for which is was intended, namely, to give reliable facts of business transactions, it would become one of the most profitable departments in your organization.

Another principle which is absorbing the minds of our eminent business men is the relationship which should exist between employer and employee. A contractor's profits rest in the efficiency of his workmen, therefore it should be the contractor's foremost thought. There is a lot of unnecessary dignity which is impressed upon the mind of the employee by the employer. This has an unwholesome tendency to widen a breach which is already dangerous between these two classes. Capital makes labor and labor makes capital, therefore, the two existing because of this relationship should be brought together in practical harmony. An employer should learn to understand his men and acquaint himself with their efficiencies and inefficiencies. Hiring and firing are indiscriminately practised without study and discretion. All business men have different ideas of conducting their business, and when an employee has been in one man's service a little while he becomes a capital investment and not as a movable commodity. There are many ways by which an employee can be interested not only in the work which he is employed to do, but in the company at large; for it is the organization which has the cooperation of all its employees that, undisturbed by turbulent feelings of its workers which in so many cases is the ruin of many, forges steadily ahead and pays dividends on an inexpensive investment of courtesy.

In closing I would urge the electrical contractors of this country to draft up a cost system, which will be applicable to your needs, and which can be cut down or elaborated on to suit the business of every contractor, be it large or small.

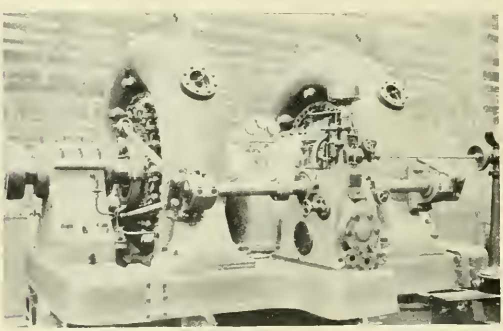
An Electrified Yellow Peril

The unparalled industrial boom Japan experienced during the last few years has brought with it an enormous increase in the demand for cheap electrical energy throughout the country and particularly in the city of Tokyo. In 1908 the Tokyo Electric Light Company completed their hydro-electric power station on the Katsura River about 100 miles from Tokyo, at this time the largest and most important power station in Japan. The total output of this plant was 27,500 h.p. developed by six Escher Wyss Francis turbines direct coupled to generators of Siemens make. One year later the company had sold the whole of the energy developed and a second plant of increased capacity had to be taken in hand. It was decided to develop a fall ten miles down stream on the same river, where 42,000 continuous horse-power could be obtained. The minimum flow of the river was measured to be 850 cubic feet per second, while the net head available varied from 368 ft. to 396 ft. maximum. By providing a reservoir of sufficient storage capacity the plant could deal with a peak load of 50,000 h.p.

The contract for the complete hydraulic installation was again let to Escher Wyss & Company, Zurich, comprising six main turbines of 12,500 h.p., including the oil pressure plant as well as the distributing piping with the necessary gate valves. With a total capacity of 75,000 h.p. not including the power required by the auxiliaries, this new installation is again the greatest power plant in Japan.

Regarding the lay-out of the plant the following may be briefly mentioned:—

The water is brought through a tunnel to the forebay and from there in six parallel pipelines of 700 ft. length and 6 ft. diameter to the turbines. Each turbine has its own pipeline, the exciter turbines being fed by a seventh pipe of smaller diameter. The main turbines are arranged in two groups, each consisting of three units, one group on each side of the switchboard. The distributing pipes and valves are on the lower floor, thus leaving the engine room proper free and allowing for easy access and attendance. For the transformers and connections a second building is provided.



Francis type turbines for Tokyo, Japan.

The pipeline for each main turbine is connected by means of a conical pipe to a gate valve of 4 ft. 7 in. diameter operated hydraulicly by pressure water taken from the penstock. A cast steel Y piece and bend connect the turbines to the main gate valves.

The main turbines are Francis, twin spiral type with horizontal shaft running at 375 r.p.m. and are coupled direct to the alternators, the coupling flanges being forged on to the shaft. Each unit is mounted on a solid cast iron base plate grouted into the engine room floor. This arrangement ensures a very accurate and simple lining up on site, easy dismantling and remounting for repairs, and equal pressure on the foundations. The shaft runs in two ring lubricated bearings of ample dimensions mounted on pedestals. The bearing on the free end is fitted with thrust collars. The lower bushings of both bearings are hollow and water cooled. The runners are made in special bronze and screwed on to flanges forged on to the shaft. The spiral casings are made in cast iron reinforced by steel bolts and guide ribs cast in. The guide apparatus is arranged outside the turbine casing, thus making all links and bolts accessible. The guide rings and covers in contact with the water have cast steel linings, which are easily interchangeable in case of wear. To reduce the distance between the bearings the draft chest has an elliptical form on the bottom. An intermediate pipe connects this draft chest to the wrought iron draft tubes.

The turbines are regulated automatically by oil pressure governors of Escher Wyss patent, mounted on the same bedplate as the turbine. The governor is the largest size of Escher Wyss standard type, fitted with speed changing device from the switchboard and with quick closing device in case of falling off of belt, thus preventing the running away of the set. The servo-motor can be operated by hand instead of automatically, by means of a hand wheel regulating the access of the oil pressure to the one or the other side of the cylinder. The necessary pressure oil for the governors is supplied by an oil pressure plant.

To prevent dangerous pressure shocks in the pipeline under sudden throwing off of load of the turbines a relief valve is provided for operating direct from the governing gearing of the turbine. The relief valve works in such a way that when the governor closes the guide vanes to a certain amount the corresponding area is opened in the relief valve. To prevent losses in water the relief valve closes automatically after a certain time.

The exciter turbines of 460 h.p. are coupled by means of flexible couplings to the exciters running at 600 r.p.m. The turbines are impulse wheels with two nozzles, each regulated by an oil pressure governor mounted on top of the casing. The oil pressure plant consists of three pump groups, each group of sufficient size to feed 4 generator turbines and governors. Each pump is driven by a small impulse wheel of about 25 h.p. running at 80-100 r.p.m. Regulation is done by hand by throttling the pressure in the needle nozzle. All parts exposed to water pressure were tested at 350 lbs. per square inch. The installation is working since October, 1912, and, according to a statement made by the company, has been a great success in every respect.

Low Voltage Transformers

To meet the demand for a small low priced transformer of guaranteed efficiency which will operate small electric trains, motors and other toys. The Thordarson Manufacturing Company, of 508 South Jefferson Street, Chicago, have recently placed on the market a new toy transformer.

In this new unit, the secondary is equipped with three taps generating three, six and nine volts. As with the other transformers manufactured by this company, every care has been taken to render this transformer indestructible. It is enclosed in a steel case and immersed in an insulating compound that makes it impervious to moisture. Each transformer is equipped with a plug and a supply of flexible cord so that it may be attached to any alternating current lamp socket.

These transformers are extremely popular with the boys. They are really a miniature power plant and the uses to which they may be put are limited only by the ingenuity of the experimenter. The larger size transformers, which have proven so popular in former years, will also be carried. They furnish current from three to twenty-six volts and three to nineteen volts.

New Line of Veeder Counters

The accompanying illustrations show a new line of counters recently brought out by the Veeder Mfg. Company of Hartford, Conn. These are in two styles termed respectively "Setback" and "Locked Wheel" counters. Fig. 1 shows the four-wheel Setback counter suitable for use in counting separate lots of work on punch presses, printing presses, looms, stamping machines, etc. Fig. 2 shows the Locked Wheel counter similar to Fig. 1. In the design of these new counters special care has been taken in making an instrument that will operate with the greatest ease. Each wheel turns upon a comparatively small shaft and the pinion which transfers the motion from one wheel to the other also turns on small shafts. The counter is built up of units, each unit consisting of a short section or shell which carries a pinion and entirely encloses the number wheel with the exception of an opening through which the figures are read. This enables the manufacturer to furnish as many number wheels as may be desired within certain limits. The usual number supplied is four, but the counter may be supplied

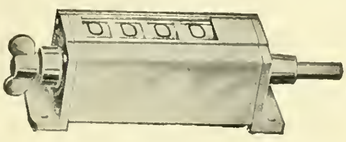


Fig. 1.

with only two or with six or eight sections. Both styles of counters are furnished with the following forms of driving mechanism:

(1) The rotary ratchet, which drives the right-hand wheel forward by an oscillating motion of the lever on the driving shaft. The driving shaft may be rotated through any number of degrees, or even revolved continuously in either direction. If driven forward, it will count ten for each revolution; if driven backward the number wheel will not be moved. An oscillating movement of from 40 to 60 degrees will count one figure at each movement.

(2) The direct drive,—in this arrangement the driving shaft is directly connected to the first or right-hand wheel and one revolution of the driving shaft will count ten. If the shaft of the Locked Wheel Direct Drive Counter is run backwards the number will be subtracted.

Fig. 2.

(3) The revolution counter,—in this mechanism the right-hand wheel is driven by a gear, which is mounted on an eccentric on the driving shaft, but is prevented from turning by a short oscillation link. It counts one figure for every revolution of the shaft.

The driving shaft in all of these counters, as customarily furnished, runs on plain bearings, but where they are desired for continuous running, they may be supplied with ball bearings. The number wheels have large figures and wide faces, so that the counter can be very easily read. There are no exposed gears which would tend to make it difficult to read the figures. The figures on the counters are ¼ inch high and can be easily read at a distance of ten feet. Each unit is ½ inch wide.

R. E. T. Pringle Specialties

The illustrations of lamps shown herewith are the latest productions of the Adams Bagnall Electric Company for the electric lighting of automobiles. They are characterized by the three features of greater illumination efficiency, unique construction features, and a reasonable price. These units are made in a factory said to have the largest punch press and spinning lathe equipment in the country devoted to the production of light-reflecting devices. The reflectors themselves are made by a combination punch press and spinning

Fig. 1.

Fig. 2

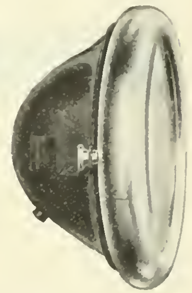


Fig. 3.

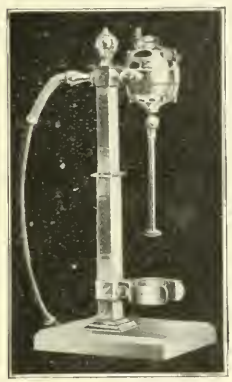


Fig. 4.

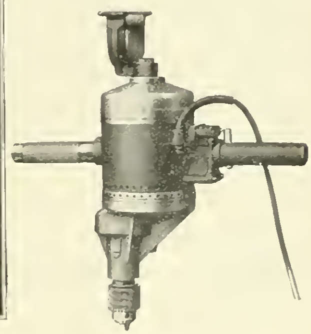


Fig. 5.

process worked out to produce the best surface upon which to apply a finish. The silver is heavily applied to the prepared brass background by electroplating which insures durability and efficiency throughout the life of the reflector. Figs. 1, 2 and 3 show types of this lamp; Fig. 4 is a new silver-plated, electrically operated, Cyclone mixer. Fig. 5 represents a new type 3/8 inch, universal Van Dorn & Dutton Electric drill. R. E. T. Pringle holds the agency for the above products.

The Keystone Traveller

The Keystone Traveller for July, 1913, issued by the Electric Service Supplies Company, Philadelphia, Pa., contains much interesting information regarding their products. The chapter on prepayment cars contains statistics compiled by the Detroit United Railways Company, showing the great decrease in accidents due entirely to their installation of prepayment cars. A very interesting letter is reprinted in connection with the chapter on automotoneers, which states that one of these devices played a very important part in a damage claim proceedings and resulted in the plaintiff's $25,000 claim being decided in favor of the operating company. Many other interesting discussions about Keystone steel gear cases, Garton-Daniels lightning arresters, automatic trolley guard, etc., will make it of interest to operating men.

Micarta

A new material known as "Micarta" designed to take the place of hard fibre, glass, hard rubber, built-up mica, press board, raw hide, moulded compounds, etc., has been developed by the Westinghouse Electric & Mfg. Company. It is used for commutator bushings and brush holder insulation, for noiseless gear blanks, as conduit for automobile wiring, as spools for spark coil and magnet windings, for refillable fuse tubes, for wireless coil separators, for arc shields in circuit breakers, for water meter discs, etc., etc. Micarta is

Fig. 1—Accidental fracture of a 6-in. Micarta tube.

of a tan brown color and is a hard homogeneous material, having mechanical strength about fifty per cent. greater than hard fibre. As proof of its uniformity of structure the accompanying illustration of a fracture produced under pressure, is shown. The tube was held tight on a metal mandrel and a compressive force was applied at one end of the tube. When the force became sufficiently great the tube split, as shown. Such a break is known as a "harmonic" fracture. The strains in a homogeneous material under stress follow a sine wave law and the photograph shows how truly homogeneous this material must have been.

Micarta can readily be sawed, milled, turned, tapped, or threaded. It is not brittle and will not warp, expand or shrink with age or exposure to the weather. There are two grades, one of which will stand a temperature of 150 deg. C. continuously or 250 deg. C. for a short period of time. It

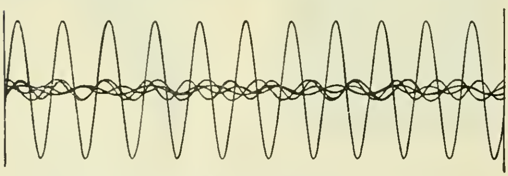


Fig. 2—Harmonic analysis of fracture wave in Fig. 1.

is infusible and will stand an electric arc better than hard fibre, hard rubber, built-up mica or any moulded insulation containing fibrous or resinous materials. Its coefficient of expansion is low, approximately .00002 per degree C. It is insoluble in practically all the ordinary solvents, is unaffected by ozone, and is impervious to moisture.

The other grade of Micarta has much the same mechanical and electrical properties but differs in its chemical and thermal properties. It behaves towards chemicals and heat very much as an ordinary resin does.

Fig. 2 shows a harmonic analysis of this break-wave from which it will be seen that the break is largely of one frequency with small sympathetic wave components of slightly lower and higher frequencies.

Sale of Assets

Tenders will be received by F. C. Clarkson, Assignee, at his office No. 33 Scott Street, Toronto, up to 12 o'clock noon on Tuesday, the 29th day of July, 1913, for the purchase of the following assets of the estate of the E. A. Greene Company, Limited, No. 145 Church Street, Toronto, consisting of, —Lot No. 1.—shades, lamps and sundries, $1,582.38; Lot No. 2.—office and shop furniture, $1,349.25.

Fuseless Rosette or Outlet Box Cover

The illustrations herewith represent a new device just placed on the market by the Pass & Seymour Company. It is called a fuseless rosette or outlet box cover and is made

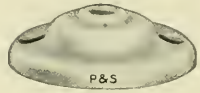


Fig. 1.

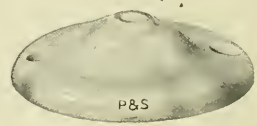
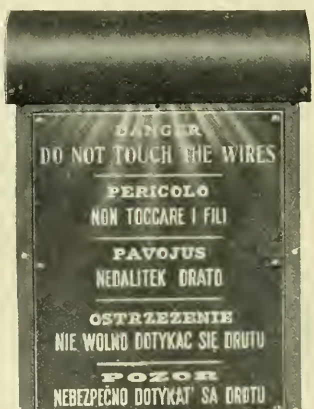


Fig. 2.

exclusively for use on outlet boxes. Fig. 1 is made for use on any of the 3-in. or 3¼-in. boxes, and Fig. 2 for use on any of the 4-in. boxes.

"Safety First" Signs

To fulfill the demand for safety appliances and to conform with the many "Safety First" campaigns carried on by railways, mining and power companies, the Electric Service Supplies Company have placed on the market a new type of illuminated sign as shown in the illustration. These signs consist of a steel frame joined at the top in the shape of a hood under which is placed a weatherproof socket for one incandescent lamp. The hood is given a coat of aluminium paint on the inside and acts as a reflector as well as a protection to the lamp. Standard enamel steel signs are attached to this frame by means of six machine screws, the standard size of the sign proper being 10 x 12 inches. These signs may read in several different languages like the one shown herewith, which portrays the message in English, Italian, Lithuanian, Polish and Slavok. They may be fitted with weatherproof condulets or bushings to protect the lead-



ing-in wires which enter the end of the hood, and to insure the proper operation of the sign after a maximum of rough usage.

These signs are used effectively in mines, power plants, and along railways or at any point where human life is endangered by exposed electric wires, switches or third rails. In mines where an illuminated sign is essential they are used extensively to warn the workman of the danger of gases, falling timbers and electric wires. For railway companies their use at stations and cross-overs to inform the public of possible danger is fully recommended. Their installation is undoubtedly an important step towards insuring the safety of workmen in mines and the patrons of railway companies.

New Books

Electricity for the Farm & Home—by Frank Koester, A.M.I.E.E. Sturgis & Walton Company, New York, publishers. Price $1.00 net. This book covers in a very helpful manner a number of the different phases of farm work as applicable to operation by electricity. The scope of the text can probably be best understood by an enumeration of the different chapters which are as follows:

(1) Benefits of Agricultural Electricity; (2) Central Station Service; (3) Generating Electric Power; (4) Electric Motor Application; (5) Cost of Operating; (6) Electricity in the Manufacture of Farm By-Products; (7) Electricity in the Preservation of Farm Products; (8) Electric Transportation of Farm Products; (9) Electric Ploughing; (10) Diverse Applications of Electricity; (11) Electric Heating; (12) Electric Lighting; (13) The Telephone in Rural Communities; (14) Electric Power in Irrigation; (15) Electric Stimulation of Vegetation. The book is well illustrated.

Electric Trucks

Two instructive booklets have just been issued by the General Vehicle Company of Long Island City, New York, dealing with "electrics" for grocers and department stores. Useful cost figures are given based on the satisfactory experience which has resulted from the operation of electric trucks under these two conditions. The operating cost figures including fixed charges, replacement charges, garage charges and driver and based on 300 days per year, are given in the following table. These figures are based on actual service in a large number of cities and under widely varying operating conditions, for electric trucks in service anywhere from six to eleven years.

Capacity	Speed	Annual Mileage	Cost Per Day
750 lb.	12	10,620	$ 6.30
1,000 lb.	12	10,500	6.85
2,000 lb.	10	10,140	7.65
2-ton	9	9,390	8.85
3½-ton	8	8,310	10.33
5-ton	7	7,200	11.60

Trade Publications

Glass Insulators—A mailing folder showing 43 designs of glass insulators has just been sent us by the Brookfield Glass Company, New York City.

High Tension Fuses: The Delta-Star Electric Company, Chicago, are distributing their copyrighted bulletin descriptive of their S. & C. Carbon-tetrachloride fuses for all voltages up to 110,000 volts. Numerous illustrations from actual installations in commercial operations are shown.

Fixture Parts.—Catalogue No. 2 issued by W. H. Banfield and Sons, 120 Adelaide street west, Toronto, describing their latest designs in ready-to-assemble fixture parts and fittings. These are made in stamped brass in any desired finish. This company also now have a branch factory at 362 Adelaide west, Toronto, to take care of their surplus orders.

Solderless Connectors—Tenth annual catalogue issued by Dossert & Company through Mr. Irving Smith, Montreal agent. The catalogue deals with Dossert solderless connectors for solid and stranded wires and includes, in addition to numerous illustrated descriptions, prices lists, code words, dimensions, and much other useful information.

Souvenirs—A handsome booklet was recently issued by the Owen Sound Board of Trade contemporaneously with the 24th annual convention of the Canadian Association of Stationary Engineers which this year was held in that town The booklet is profusely illustrated and forcibly sets forth the attractiveness of Owen Sound as a power and manufacturing centre

Tips for Tourists—a folder issued by the British Columbia Electric Railway Company describing interurban side trips which may be made over the different railway lines of this company in the vicinity of the cities of Vancouver and Victoria. The Folder is well illustrated and also contains a map showing the extent of the company's lines.

Supplement Catalogue—The Electric Service Supplies Company have issued a new supplement to Catalogue 4, Volume 2, listing, describing and illustrating many new devices recently placed on the market by this company in addition to its line of car equipment and supplies. This new supplement catalog contains the first complete listing ever published of Imperial luminous arc head lights and parts and a full listing and description of Keystone Car Destination Signs. Other new devices listed are the International Coin Registers, Keystone Vacuum Sanders, Keystone Pneumatic Gong Ringing devices, Keystone Trolley Catchers, Keystone Steel Gear Cases, Keystone Trolley Pick ups, Union Standard Trolleys, Sanitary Hand Strap Covers, Keystone Cord Connectors, Garton-Daniels Lightning Arresters, Automotoneers, Keystone Motorman's Seats, Keystone Lamp Guards, Keystone Air Valves and many other devices which will make it of great interest to operating men.

Recent C. G. E. Publications

How to Wire a House—an instructive pamphlet which points out that there is no reason for the supposition, unfortunately too common, that the wiring of a ready built house involves extensive alterations and turmoil.

Dossert Solderless Connectors—Dossert Connectors eliminate entirely the use of solder in making electrical connections and splices. By their use much labor is saved and splices obtained that will withstand any overload. They are described in a folder just issued.

How to Solve the Power Problem—is the title of an interesting little pamphlet issued by this company who can furnish a motor for every machine; a controller for every motor, and engineers to advise in their application.

Bulletin A4113—describing oil switches for small capacity industrial application. These oil switches, known as Type F, Forms P3 and P6, are designed specially for use in industrial plants in connection with induction motors of capacities not in excess of 25 horse-power at 600 volts, or with normal current ratings not greater than 50 amperes at voltages less than 600. They are arranged for mounting directly on a wall, post, or, where used with spinning frames in textile mills on the frame itself. When mounted on the spinning frame the switch is operated by a shipper rod. The live parts being entirely enclosed, the switches are particularly suitable for use in factories in which the air contains inflammable particles, or where explosive materials are prevalent.

The Century Electric Company announce that they have appointed the Rudel-Belnap Machinery Company, Limited, Canadian Express Building, Montreal, Que., as district sales agents for the provinces of Quebec, New Brunswick and Nova Scotia, who will handle the complete line of "Century" single phase motors, "Invincible" split phase motors and "Century" fans for the above territory.

The Good Salesman

It isn't what a man eats, but what he digests that makes him strong; not what he earns, but what he saves that makes him rich; not what he reads, but what he remembers that makes him learned—and it isn't the orders he takes, but those he doesn't miss that makes a salesman

Current News and Notes

Aurora, Ont.

On August 4 a by-law will be voted on authorizing the expenditure of $21,000 on the electric distributing system.

Brandon, Man.

The first report submitted by Superintendent Antonisen on the operations of the new street railway system showed that the average daily number of passengers carried was approximately 2,900, showing average daily receipts of about $135 as against $105 for operating expenses, not including interest and sinking fund charges.

Calgary, Alta.

Following negotiations for the supply of power to the Western Canada Milling Company it is reported that the city of Calgary will develop the necessary power, using gas engines, and will sell to the company at $30 per horse-power year for 1,000 horse power.

Chapleau, Ont.

A by-law was submitted on July 21st approving a franchise agreement between the Chapleau Electric Light and Power Company and the corporation of the township of Chapleau. The by-law was defeated.

Carlyle, Sask.

On August 4th the electors of the town of Carlyle will vote on the question of expending $10,000 to provide an electric light and power system.

Fort Frances, Ont.

Following a re-organization of the railway system in International Falls, the town situated just across the Rainy River from Fort Frances, there is a suggested possibility that a belt line connecting the two towns would be a good business proposition and may be a reality in the near future.

Gravenhurst, Ont.

The corporation of the town of Gravenhurst are at present building a new concrete dam at South Falls to replace the old wooden one that has been in commission for many years.

Hamilton, Ont.

The Canadian Pacific Railway Company are considering the construction of a new line between Hamilton and Niagara Falls and passing through St. Catharines. It is said that this line may be electrically operated.

Hull, Que.

A by-law was recently passed authorizing the expenditure of $21,000 on a new generator to take care of 100 supplementary arc lights for street illumination.

Kingston, Ont.

Tenders will be called shortly in connection with the work of placing sections of the overhead distribution system underground.

London, Ont.

Mr. A. Eastman, manager of the Windsor, Essex and Lake Shore Railway Company, has completed an estimate on the earnings and operating expenses of the London and Port Stanley, under electrification. Mr. Eastman places the surplus over operating expenses at $75,000, against which there would be fixed charges of approximately $90,000, leaving a considerable calculated deficit.

Extensions to the main sub-station are under way. Contract has been awarded for the brick work to Hyatt Bros.

Medicine Hat, Alta.

Tenders will be called immediately for the erection of a three-storey telephone building. The exchange is being installed by the Alberta Government.

Montreal, Que.

The Builders' Exchange of Montreal is planning a big excursion of its members to New London, Conn., Aug. 15-18.

The Montreal Board of Control have refused to grant a site on Mount Royal for a wireless station, as requested by the Marine and Fisheries Department. The objection to the station is that it would disfigure that part of the mountain and would deprive the citizens of a portion of their park.

At Nobel, near Parry Sound, Ont., the Canadian Explosives, Limited, Montreal, are erecting a new plant, at which will be manufactured the various products of the company. Part of the plant will be operated by electricity, and for this purpose the company will install a generating set. There are to be two 125 kv.a. a.c. generators, supplied by the Canadian Westinghouse Company, direct connected to two 160 horse power Robb-Armstrong simple Corliss engines. The generators will be of the 600 v. 60 cycles type, while the motors, about 25 in number, will range from one to 20 horse power. This plant will also be used for electric lighting. The energy will be distributed by two power circuits and a lighting circuit.

The Canadian Crocker-Wheeler Company, Limited, of St. Catharines, Ont., have opened an office in the McGill Building, Montreal, under the management of Mr. Mugg. Prior to the opening of this office, the company's products were handled in Montreal through agents.

The Montreal Board of Commissioners have decided to accept the tender of the Canadian Allis-Chalmers Limited, Montreal, for the supply of an electric-driven pump, 6,000,000 gallons capacity, for the high level reservoir in that city. The amount of the tender is $6,356. The pump is to be built according to the design of Mather & Pratt's patent high lift turbine pump, and is to be direct connected to a motor. The pump will be manufactured at Rockfield, P.Q., is to lift against a total head of 266 feet, and run at 875 r.p.m. A 455 h.p. single unit motor is required, but the type is as yet not decided upon. The tender of the Allis-Chalmers Company was higher than others sent in, but the Commissioners accepted it on the recommendation of Mr. Janin, the chief engineer.

With a view to financing the addition to their hydro-electric power plant at Grand'Mere, P.Q., the Laurentide Company, pulp and paper manufacturers, have issued $2,400,000 of new stock. This will cover the estimated expenditure for the next two years. The work now proceeding will bring the present 22,000 h.p. up to 75,000 or 80,000 and eventually to 100,000 h.p. This increased development will provide for any probable future expansion of the company's mills, and at the same time afford a large amount of surplus power. The company state that enquiries have already been received for a considerable portion of this power at profitable rates. The present 22,000 h.p., which is entirely used for the work of the mills, afforded for the year ending June 30th, 1912, a net profit of more than $38 per h.p. The engineer is Mr.

Geo. Hardy, of New York, and the contractors the H. E. Talbott Company.

Some months ago, during the absence of the Mayor of Montreal, Ald. Mederic Martin, the acting Mayor, signed a contract authorizing the Montreal & Southern Counties Railway to extend their local terminal facilities—an action disapproved by the Commissioners. An action has now been entered by Mr. Donald Robertson, a shareholder in the Montreal Tramways Company, having for its object the setting aside of the signature of Ald. Martin on the ground that it is illegal. The action asks that the contract be cancelled and that the Montreal & Southern Counties Railway be refused the extensions authorized. The Tramways Company claim that the contract encroaches upon the privileges accorded the company by their original franchise. The Montreal & Southern Counties Railway have for a long time been asking for new terminal facilities, the present ones being wholly inadequate for the expanding traffic of that company.

It has been decided by the Montreal Tramways Company to obtain rulings, before the highest courts if necessary, in order to test the extent of the company's powers in dealing with passengers who refuse to comply with the regulations. The recent "no smoking" rule has resulted in considerable friction and several prosecutions.

Mr. W. H. Reynolds, western manager of the Eugene F. Phillips Electrical Works, Limited, Montreal, has been on a business visit to Montreal.

The Bell Telephone Company have opened a new exchange at the corner of Chateauguay and Charlevoix streets, Point St. Charles, Montreal. The great expansion of the business in the city is shown by the new directory just issued. Since February about 3,000 new names have been added, making a total of 46,368, of which 57 per cent. is for business purposes. It has been found necessary in order to reduce the bulk of the directory to arrange the names and addresses in two columns on a page and to reduce the size of the type.

New Toronto, Ont.

A by-law was recently carried authorizing the expenditure of $7,000 for the erection of a distribution system.

Ottawa, Ont.

It is reported a new bill will be introduced next session regulating the light and power rates charged by companies operating under Dominion charters. The power of regulating the rates would be fixed by the Dominion Railway Board.

The subscription rights for the new issue of $800,000 of capital stock of the Ottawa Light, Heat and Power Company, were all taken up by July 15th, the day the rights expired. The capital stock of the company is now $2,800,000 and the extra capital will be used to cover the cost of the new half million dollar gas plant now being built in Ottawa East as well as several improvements and alterations to the electric light system owned by the company. The new issue was offered to shareholders on record of July 1st at par. Each shareholder was allowed to buy one new share for two and a half already held. On July 15th Ottawa Power stock was selling at 168.

The Ottawa Electric Railway Company is adding five miles of tracks to their system this year at a cost approximately of $150,000. When these extensions are completed before the snow flies the total mileage operated by the company will be fifty-five. Two new booster stations, which have been mentioned in a previous issue of the Electrical News, are being built at a cost of $120,000; and $160,000 is being spent on twenty new double-truck cars, which will be ready some time early this fall.

Regina, Sask.

The operation returns for the week ending July 12 for the Municipal Railway System of the City of Regina was,—passengers carried, 95,251; revenue, $3,878.15.

St. Catharines, Ont.

The Bissell Motor Company of Canada, Limited, has been incorporated with a capital of $50,000, to manufacture and deal in electrical apparatus of all kinds with head office at St. Catharines.

Selkirk, Man.

On July 15th a by-law was passed favoring the operation of the electric railway system on Sundays. This probably means a Sunday service, in the near future, between Winnipeg and Selkirk.

Toronto, Ont.

Experiments will be made on the purification of water by electrolysis.

It is again rumored in connection with the purchase of the Toronto Railway and the Toronto Electric Light properties that the government may at the same time take over the generating plant of the Toronto Power Company, which supplies energy for the two Toronto companies.

It begins to look as if the Forest Hill line might not be constructed. The township council are opposed to the granting of a franchise.

By-laws authorizing the municipalities concerned to enter into contracts with the Hydro-electric Power Commission of Ontario, were carried by decisive majorities in Drumbo, Princeton, Plattsville and Ayr.

The committee recently appointed by the city council to make the report on the value of the assets of the Toronto Electric Light Company and the Toronto Railway Company have commenced their work and expect to have a report for submission to council by August 15th. The committee consists of Messrs. B. J. Arnold, R. A. Ross, J. W. Moyes, and John Mackay (chartered accountant).

The wage dispute between the electricians and the Toronto Hydro Electric Commission has been amicably settled according to the following schedule which rules for linemen, jointers, mechanics and helpers,—

Linemen,—Class A, 37 cents per hour; Class B, 34 cents per hous; Class C, 31 cents per hour. Helpers,—Class A, 30 cents per hour; Class B, 27½ cents per hour.

Cable jointers,—Class A, 38 cents per hour; helpers, 27½ cents per hour.

Electrical mechanics,—Class A, 41 cents per hour; Class B, 38 cents per hour; Class C, 34 cents per hour; Class D, 32 cents per hour. Helpers,—Class A, 30 cents per hour; Class B, 27 cents per hour.

It is also agreed that these men shall be given all legal holidays with full pay and alternate Saturday afternoons.

A site for the car barns of the St. Clair section of the municipal railway system has been purchased at Benson and Bracondale streets.

Windsor, Ont.

A police alarm system will be installed here and 3,500 feet of cable will be required.

Winnipeg, Man.

The Sons of Jove to the number of 150 recently held their annual picnic at Winnipeg Beach.

New tenders are called for the manufacture, delivery and erection in the generating station at Point du Bois, of two 5,000 kv.a., 3-phase generators for direct connection to double reaction turbines.

Electrical News
Generation, Transmission and Application of Electricity

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Isolated Plants as Off-Peak Load

In spite of all the convincing arguments against the installation of isolated plants where central station service is available the number of these plants continues to increase at a very fair rate. While we believe these installations often represent errors in judgment when initial cost, depreciation, operation, valuable floor space, continuity of service and all the other little contingencies are reckoned, still there is the feeling of independence and freedom that often means more to a wealthy firm than dollars and cents. Much too, of course depends on the heating requirements which, generally speaking is the deciding factor.

In the past, central stations have looked on these small plants with disfavor but it is quite open to question if they cannot, under proper treatment, be made to work out as an actual advantage to the larger plants. The day is fast approaching when auxiliary generating equipment whether for steam, water or other prime mover, will be considered an essential to meet the modern ideal of continuity of service. It is quite conceivable that in a city of ordinary size there may be isolated plants with sufficient added capacities to take care of the more important part of the city load, especially as the central station trouble may arise at hours when the isolated plants may not be operating. Such a possibility, of course, presupposes an advanced stage of standardization and co-operation—a condition much to be desired and toward which we are plainly advancing.

But the isolated plant and the central station can cooperate, to the advantage of each, in another way and without delay. The chief reason for the installation of the majority of isolated plants is that boilers are required, anyway, for heating or other purposes. These however are rarely required during the summer months, and the owner of an isolated plant would naturally be willing to tie up to the city company during the summer if rates could be arranged satisfactorily. It also happens that this season is the light load period for the larger systems, when they perhaps can also afford to give somewhat lower rates. Looked at from this point of view the isolated plant can be made a most desirable customer in that it can be dropped during the heavy winter load period and taken on again during the summer. Under proper adjustment it looks as if any antagonism of the central stations towards their weaker rivals should give place to co-operation.

Steam Road Electrification

The recent announcement by the Canadian Pacific Railway Company that they will electrify immediately a section of their line in British Columbia, this to be followed by further electrification if this Canadian innovation proves a success, brings to mind once more the fact that there are a number of points in Canada where at the present time this very question of electrification is being discussed. Particularly in the Montreal district and from Montreal to Ottawa and possibly to Toronto there can be little doubt but that electrical equipment will be installed within the very near future.

As bearing on this question a recent paper by Mr. H. M. Hobart before the American Institute of Electrical Engineers brings out in a very thorough, interesting and lucid manner, the present-day situation with regard to the financial aspect of the electrification of the mountainous sections of Western North America. The paper points out that engineers in general have over-estimated the magnitude of the requirements of such a line as far as current consumption is concerned. It is stated as an example, that seventeen locomotives of 80 tons carrying 5,000,000 tons per year an average distance of 26 miles would require only 20,000,000 kw. hours and yet a 5,000 kw. motor generator often turns out this much energy in a year. On a 26-mile line only two substations would be required and four 1,000 kw. motor-generators and the only items of large expense would be the seventeen locomotives and the overhead wires, the track bonding and the negative feeders.

Considering the capacity of many of the large hydro-electric plants operating in the vicinity of the Rockies it is pointed out that the quantity of power required by the railway systems would therefore, be a matter of comparatively small importance. Therefore, the load factor, though generally low in railway service, is not of prime consideration. The fact, however, that synchronous motors have such a satisfactory effect on the regulation of the line is often lost sight of, but is of such importance that it may well be taken into consideration by the central station as it will justify a very low rate to the railway company.

Regarding economy of operation the paper points out that owing to the lighter weight of the electric locomotive the total weight of the train is better distributed. Also, there is more uniform torque as compared with the pulsating torque of the steam engine. It is also pointed out that in steam operation the efficiency from coal to drawbar is probably not higher than 2.32 per cent. as against 6.5 per cent. for electricity. The electric motor requires only one skilled engineer and a helper, simply as a safety factor; the steam locomotive requires three men. While the electric locomotives cost more they actually work out the cheapest in the end, considering the greater amount of work that can be done, the reduced maintenance charges and the very important item of less time lost for repairs. Specific figures on a 96 mile electrification are given in full. Extracts of Mr. Hobart's paper are given on other pages of this issue.

No Sign of Wreck

The current issue of the Bulletin of the National Electric Light Association, commenting on the discussion at the recent Canadian Electrical Association Convention with reference to continued affiliation or the formation of an association to include municipal plants, draws attention to the unusually large number of municipal plants in Canada, and takes occasion to refer in apparently unwarranted terms to the financial aspects of the Ontario Government distribution scheme, which it describes as "a financial wreck." We are unable to say what the source of the Bulletin's information may be, but presumably it is not different from the reports that have been made generally public, from which it would appear that there is at least room for argument. In the interpretation of figures over which there have been many different expressions of opinion we believe the Bulletin might have hesitated before making a statement laden with such damaging possibilities to the credit of the province concerned.

To all visible and physical appearance Ontario's system of distribution is admirably fulfilling the work for which it was installed. There is no question of its engineering efficiency or of its reasonable cost. Further, the total load has increased beyond the expectations of the promoters, and extensions at present going forward, at nearly every point of the system, have been forced on the Commission as a result of the co-operative demands of the sections served. The principle of municipal ownership may be all wrong but we think it only fair that the credit of our country should not be attacked until there is some more certain sign of the impending "wreckage."

Free Renewals of 100 Watts and Over

The custom of giving free carbon lamp renewals which was formerly a common practice with central stations before, and since, the advent of the tungsten, has not been extended to include the latter on account of the greater cost, smaller consumption and, often, shorter life of the metal filament type. With increasing improvements in manufacture, however, it is probable the custom will again become general as is indicated by the fact that some companies are already replacing, free of charge, tungsten units of 100 watts consumption and over and allowing a graded reduction on the smaller lamps.

In this connection the Electrical World of August 2 publishes an announcement of a number of the Edison Companies regarding reductions in prices of tungsten lamps. The New York Edison Company, The Commonwealth Edison Company of Chicago, The Edison Electric Illuminating Company of Brooklyn and others have placed all tungsten lamps of 100 watt rating and larger on a free renewal basis. The Brooklyn Edison Company also sell 10, 15, 25, 40 and 60 watt lamps whether plain or frosted at the uniform price of 20c. The Detroit Edison Company, following a similar policy, have made arrangements with local firms handling tungsten lamps to renew all the lower sizes for their customers at a uniform rate of 30c. The New York Edison Company and the United Electric Light & Power Company have adopted a graded scale of prices in which the smaller lamp has the higher price, the schedule being as follows: 10 watt lamps, 28c; 15 watt lamp, 25c; 25 watt lamp, 18c; 40 watt lamp, 16c; 60 watt lamp, 14c. For frosted lamps an extra charge of 2c is made. The Buffalo General Electric Company sells clear bulb tungstens rated 25 to 40 watts for 30c, and other sizes as follows: 60 watt, 35c; 100 watt, 65c; 150 watt, 95c; 250 watt, $1.60; 400 watt, $2.90 and 500 watt, $3.20. Reductions have also been placed in effect in Philadelphia, St. Louis, Boston, Minneapolis and Cincinnati. The Hartford Electric Light Company, some time ago placed tungsten lamps of 60 watt rating and over on a free renewal basis.

Another 9,000 h.p. for Rossland

The unique position occupied by the Canadian General Electric Company, Limited, in the design and construction of hydro-electric power machinery is well shown in the contract recently awarded by the West Kootenay Power and Light Company of Rossland, B.C. In order to increase the capacity of their plant the latter company decided upon the addition of a 7,500 kv.a. water-wheel driven generator. The Canadian General Electric Company will build the generator while the contract for the water-wheel was placed with the subsidiary Canadian Allis-Chalmers, Limited. This water-wheel will have a capacity of 9,000 h.p. at 180 r.p.m. under a head of 70 ft. The contract therefore will be carried out practically by one firm who are thoroughly familiar with the design and construction of both the electric and hydraulic portions and with the conditions necessary for their successful operation as one unit.

It is understood that the increase in the generating capacity of the West Kootenay Power and Light Company has been undertaken in anticipation of the electrical requirements of the Canadian Pacific Railway Company who intend to electrify the line between Rossland and Castlegar. The contract for the electrification of this section of the railway was, it will be remembered, also awarded a short time ago to the Canadian General Electric Company.

Series of Large Plants

The secretary of the U. S. Department of Agriculture has just issued a permit to the Pacific Light and Power Corporation of Los Angeles, California, to construct and operate a series of power plants in the Sierra national forest. The company plans to build four power houses, two reservoirs, and twenty-five miles of cement-lined tunnels. On account of the magnitude of the construction work and the amount of power to be disposed of, the permit provides for construction extending over a period of twelve years. Under a temporary permit the company has already nearly completed the first step of this development, known as the "Big Creek Project." This work is being done by the Stone and Webster Engineering Corporation.

The ultimate development proposed is about 150,000 horse-power. The greater part of this power will be transmitted 240 miles into Los Angeles and vicinity and will probably be used in large part on further extensions of interurban railway systems. It is also expected that considerable quantities of this power will be utilized in pumping water for irrigation in the upper San Joaquin valley. The power will be transmitted over a double steel tower line strung with stranded aluminum cables and at a pressure of 150,000 volts, the highest yet attempted in commercial transmission.

This development of the Pacific Light and Power Corporation is one of several under way or projected upon national forest lands in California. Among these are the projects of the Great Western Power Company on the north fork of the Feather River where a reservoir of forty-three square miles is to be constructed and power plants with a capacity of about 350,000 horse-power is to be built. The Southern California Edison Company is planning for the development of four plants on the Kern River. The Pacific Gas and Electric Company is constructing on the South Yuba, one of the highest masonry dams in the world. The greatest water-power development in the history of the state is now under way and most of the plants proposed or being constructed will occupy national forest lands under permit from the secretary of Agriculture.

The storage battery fleet operated by the Municipality of the City of Calgary.

Electric Trucks in Calgary

The city of Calgary recently purchased 7 electric trucks comprising one 5-ton, two 3-ton, two 1-ton, and two 1,000 gallon sprinklers and flushers. The complete outfit is shown in one of the accompanying photographs and the sprinklers are shown in action in the other picture. It is difficult to imagine a scene that would speak more forcibly of the rapid development of the West and their progressive attitude in all the phases of modern business life. We are indebted to Commissioner A. G. Graves, of Calgary, for the photos and the gratifying information that "electrics" are proving entirely satisfactory in meeting municipal requirements.

In regard to mileage, Commissioner Graves states that they make from 40 to 45 miles per day with the one-ton trucks, without boosting them at noon. The three-ton truck that is used in the Stores Department is doing very good work, so far as mileage is concerned. It has recently been hauling 6,090 lbs. of cement a distance of about 3½ miles.

Two storage sprinklers in operation, Calgary.

Nearly half of this distance is on paved streets, but after this there is a 11½ per cent. grade of about 1,500 ft. in length, which is still in an unimproved state. Beyond this there is about one mile of mud roads. They have been getting about 39 miles per day out of this particular truck, under the above mentioned conditions, without boosting when the roads were in a dry condition. On the other hand, when the roads are wet and slippery, it is necessary, to get the above mentioned mileage, to boost the batteries during the noon hour. So far they are getting splendid results, and the Commissioner has no doubt but that the operative costs will be well below the estimate which was compiled at the time of purchase.

Radioactivity and the Age of the Earth

The heating effect of radium and the other radioactive substances has an important bearing upon the problem of the age of the earth. You know that there has been a long-standing controversy between physicists and geologists about this problem. There are two principal methods of getting an estimate of the earth's age by physical reasoning. One method is to calculate the time required for the sun to reach its present size by contraction from an infinite sphere, radiating the heat thus produced at the rate determined by measuring the heat received in unit time on unit surface of the earth. The other method is to calculate the time it would take the earth to reach its present temperature, or rather its present rate of increase in temperature (about 1 deg. cent. in 100 feet) downwards from the surface. These methods give as the limiting age of the earth something between twenty and sixty million years. Now this is altogether too short a time to satisfy geologists, who base their reasoning partly on the fossils found in the different geological strata, and partly on the salt content of the oceans, assuming this to have been brought there from the land.

Lord Kelvin was careful to state that his low estimate of the age of the earth depended on no other source of heat energy being found. We now know that there is another source of heat energy, and that is the heating effect of radioactive substances. Nearly all rocks found on and near the surface of the earth are radioactive. The amount of radium contained in the common rocks in different parts of the world varies between wide limits. Some have a radium content as low as 1 $2/10^{13}$ grams of radium per gram of rock. But on the average, the surface rocks have a radium content of about $2/10^{12}$ grams of radium per gram of rock; they also contain about $6/10^{6}$ grams of uranium and $1.2/10^{5}$ grams of thorium per gram of rock. If it is assumed that these proportions hold throughout the earth, there would result, from the heating effect of radioactive substances alone, more than ten times the amount of heat that is necessary to account for the present temperature gradient of the earth. So it is probable that the interior of the earth contains far less radium than is indicated by the surface. As a result of the discoveries in radioactivity, physicists will now allow the geologists all the time they require for the earth to have reached its present state.

There is another interesting application of the study of radioactivity to geology. If the amount of helium in a mineral be measured, and it be assumed that all the helium is a result of radioactive disintegration, a minimum estimate of the age of the mineral can be determined. Such estimates lead to times varying from 200 million years to 1,600 million years.—(From a lecture on "Radioactivity" before the A. I. E. E., by E. P. Adams).

Equipment of the Windsor Hotel

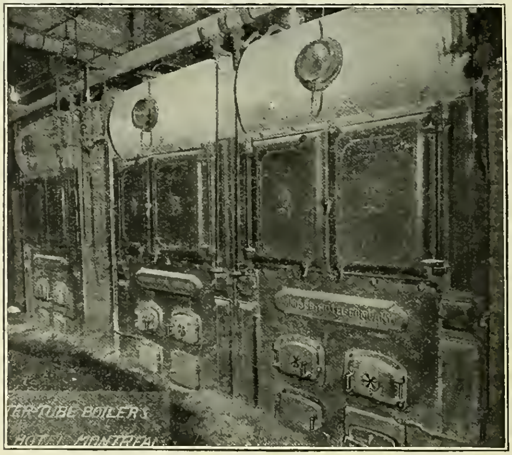
A New Isolated Plant in Montreal—Complete Electrical Equipment Throughout

The power equipment for the new Windsor Hotel, was designed and installed under the supervision of Mr. R. S. Kelsch, consulting engineer. This plant, which is in charge of Mr. Winkworth, chief engineer of the Windsor Hotel Company, is one of the most up-to-date isolated power plants in Canada. The main object of the plant is to furnish light and heat to the hotel and power for the various motors used in the laundry, for ventilating fans and in other parts of the hotel.

The steam equipment consists of three 200 h.p. Robb water tube boilers each with a heating surface of 2,143 square feet. Two of the boilers are set in a battery and one is installed singly. The boilers, which are built for 175 pounds working pressure, are equipped with cotton blowers for burning anthracite screenings. This type of boiler consists of two horizontal cross drums with headers which are connected by a main bank of inclined tubes. The drums are connected by two rows of horizontal tubes which complete the path of circulation for the water. At the extreme top, superheating tubes connect the drums so that the steam which is separated in the front drum is thoroughly dried and slightly superheated when it enters the rear drum from which it is piped to the engines.

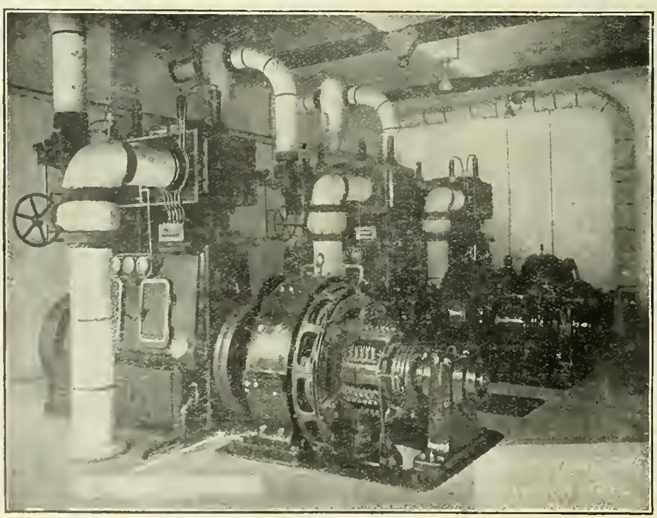
In the engine room of this power plant there are installed three Robb vertical compound engines which are run noncondensing. Each engine is direct-connected to a 150 kw. electric generator made by the Canadian Westinghouse Company. These engines will operate the generators at 25 per cent. overload for two hours and 50 per cent. overload for one hour. With steam at 150 pounds pressure they will carry the normal load at a speed of 425 r.p.m. These engines are entirely enclosed so that working parts are protected from accident and there is no danger of oil being thrown about the engine room. Every revolving and sliding part is automatically lubricated by a system which consists of a pump and distributing pipes in which a pressure of from 10 to 20 pounds per square inch is maintained. Of the vertical type, these engines have many features which have been very successful in marine practice and modified for stationary practice enable the engines to maintain the speed desired for direct connection.

The electrical equipment had to take into account the fact that for some few years the hotel is under contract with the Montreal Light, Heat & Power Company for current so that electrical machinery will be used only as a stand-by during this period. This situation called for especial skill in design because the Power Company operates with alternating current generators which means that the direct current switches of the hotel must remain open except in the event



Windsor Hotel, Montreal– Boiler Room

of a shut down on the part of the Power Company. Should this happen the engines in the new power house will be started, the bus bars made alive therefrom and the circuit breakers and the switches on the feeders closed. Signal lamps indicate when the alternating current switches are closed and the direct current switches are open. These signals will enable the station operator to properly manipulate the switches so that the entire lighting system of the hotel will be transferred from the dead alternating current bus to the working direct current.



Windsor Hotel, Montreal—Engines and Generators.

Electrical equipment for the laundry is interesting in that the individual drive is used throughout, and in addition the body ironers are electrically heated and all hand ironing is done electrically. The washing machines and extractors have individual motors, those for the washing machines being controlled from a master switchboard located in the engine room adjacent to the main switchboard. The circuit breakers and controllers are so arranged that the washing machine attendant simply presses the starting button, the machine making two revolutions in each direction until stopped by the pressing of the stop button.

The stopping and starting of the extractors is also accomplished by the push button method but in this case the attendant must keep the starting push button pressed until the extractor has attained almost full speed. This arrangement is necessary because of the possibility of the basket being out of balance. With this arrangement the attendant cannot leave or neglect the machine; he must stand by and observe what is happening until everything is safe.

Motor-Converters—Theory, Design and Uses

A discussion of motor-converters as compared with motor-generators and rotary-converters—Efficiency and adaptability

In the conversion of alternating current to direct there are three common and distinct types of equipment—each of which is more and more coming to be recognized as covering its own special field—the motor-generator, the rotary or synchronous converter and the motor-converter.

For the more rugged work motor-generators have been the most favored with many electrical engineers, but their efficiency is lower than the other two types of apparatus and they are not reversible except where the motor is of the synchronous type. In construction this equipment consists of an a.c. motor which operates a d.c. generator on the same shaft. This equipment requires no transformers, the motor being operated direct from the distributing voltage.

A rotary converter consists of an a.c. motor and a d.c. generator combined in one machine. On the commutator side its performance is that of a d.c. generator while on the collector side it operates as an ordinary motor. With this equipment it is necessary to use transformers and it is found also that the inherent characteristics of the machine do not admit of its working satisfactorily on cycles above 30, or at most 40, unless the voltage is very low. The efficiency of the rotary converter is greater than that of the motor-generator.

The motor-converter is a more recent type of machine and in appearance practically duplicates the motor-generator. It consists of two machines, the revolving parts of which are

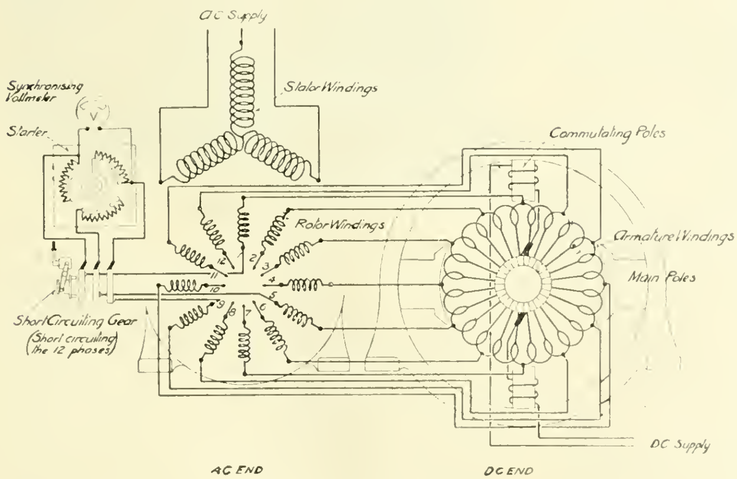


Fig. 1—Wiring diagram of motor-converter.

mounted on the same shaft, but the input machine performs the function of a frequency converter while the output machine is similar to a rotary converter, that is the motor-converter is a rotary converter into which current is fed at the proper frequency by a frequency changer.

The advantages of the motor-converter for single phase service are particularly marked because the synchronous force of a single-phase set is practically as powerful as it is in a poly-phase converter, this being due to the fact that the rotor of a single-phase converter is also wound with twelve phases. Therefore the difference between the efficiency of the single-phase and a poly-phase converter is less than the corresponding difference in the case of synchronous converters or motor-generators. It is claimed that in comparison with a motor-generator, the motor-converter is more economical in first cost and 2.5 per cent. more efficient in operation. In comparison with a synchronous converter and the necessary bank of transformers the motor-converter is about as expensive in first cost and its efficiency about one per cent. less than the synchronous converter. The motor-converter however, is claimed to be better than the synchronous converter for frequencies above about 40-cycles on account of the improved commutation at the low frequency used in the d.c. portion of the machine. For frequencies below 40 the synchronous converter may therefore be considered preferable. It is claimed however, that even under the most favorable circumstances, the motor-converter affords much better control of the voltage of the energy delivered and requires less skilled attention.

The theory and design of the motor-converter can be better understood by reference to the accompanying diagram of connections of a standard unit. From this diagram (Fig. 1) it will be seen that a motor converter consists of an ordinary induction motor, the a.c. end, and a rotary converter, the d.c. end, rigidly coupled together, the rotor winding of the a.c. end and the armature winding of the d.c. end being connected in parallel. For the sake of simplicity, it may be assumed that the a.c. and d.c. ends have the same number of poles—in the case shown in the diagram, 2 poles, and, leaving out the question of starting, assume that the combined rotor and armature is running at a speed corresponding to half the primary frequency, or, in other words, that the rotor is running with 50 per cent. slip. It follows that the revolving field, induced in the rotor by the alternating current circuit, rotates, relatively to the rotor, at a speed corresponding to half the frequency of the supply circuit, and it thus induces in the rotor windings a series of e.m.f's which have also half the frequency of the supply circuit. Now the number of poles of the d.c. end is so arranged that the frequency of the currents induced in the armature winding at the above-mentioned speed is the same as the frequency of the rotor currents, and on account of this it is possible to connect the rotor and armature windings together (provided they each have a suitable number of turns) when their e.m.f's are equal and in phase. When this is done the speed remains constant, the two ends thus connected in tandem, behaving as a single synchronous machine.

As the rotor revolves at a speed corresponding to half the frequency of the supply circuit half the electrical energy supplied to the a.c. end is converted into mechanical energy and transmitted by means of the shaft to the d.c. end, while the

other half of the energy supplied is transferred to the a.c. rotor winding and thereby to the d.c. armature winding in the form of electrical energy; thus the a.c. end operates half as motor and half as transformer, while the d.c. end operates half as continuous current generator and half as rotary converter. As the size of the a.c. end depends on the speed of the revolving field, and not on that of the rotor, it is theoretically, at the same speed, half as large as it would be if it converted the whole of the electrical input into mechanical energy. The d.c. end, running at a speed equal to half the frequency of supply, which is more advantageous with regard to commutation, is of smaller proportions than an ordinary continuous current generator or rotary converter for the same output and frequency.

The rotor is generally built with twelve phases, as the losses in converting half of the energy from a.c. to d.c. are then reduced to a practical minimum. A further increase in the number of phases has no material advantage.

The synchronising current taken at no-load is only the wattage necessary to cover the no-load losses, the absence of higher harmonics being due to the feature of the revolving field, and to the high reactance of the a.c. end.

From the foregoing it will be seen that, although the motor-converter is started like an ordinary induction motor-generator, yet when in service it runs synchronously with the main supply, being thus a synchronous converter, and as such is of great advantage in traction installations. The actual power-factor of, say, a 500 kw. motor-converter, under service conditions, would vary between .96 and unity from half to full load.

Motor-converters used for lighting are shunt or compound wound according to the requirements, standard shunt machines being arranged to have about 5 per cent. voltage drop from no load to full load, with practically unity power-factor at all loads. The efficiency, especially at low loads, is remarkably high. Compound machines may be arranged with a rise or drop in voltage of as much as from 10 to 12 per cent. A large drop is, of course, sometimes desirable, as for instance when a battery "floating" on the bus bars is in use, this being common practice in sub-stations.

In many cases it is desirable that the converting plant shall be capable of supplying at different times a traction system at 500-550 volts and a lighting system at, say, from 440-480 volts. The motor-converter is eminently suitable for these conditions, the ordinary method of increasing the voltage by shunt regulation being available with motor-converters as with ordinary d.c. generators. The conditions, however, lead to increased dimensions and a somewhat lower power-factor. Several such motor-converter installations are in successful operation under conditions which necessitate a voltage regulation of as much as 40 per cent.

When motor-converters are used for three-wire supply

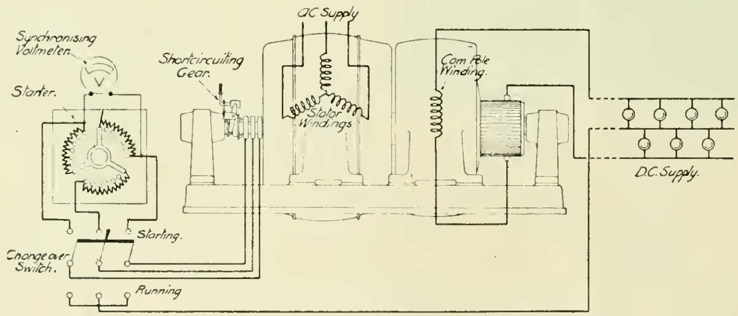


Fig. 2—Motor-converter used for 3-wire supply.

has many of the important features of the synchronous motor-generator, in addition to the other valuable features already mentioned, which are unattainable with any other converting plant. In this connection it might be specially emphasised that a motor-converter can be used for power-factor correction at a certain predetermined load and voltage ratio.

Spare or standby motor-converters may also be used solely as power-factor improvers. When a motor-converter is to be used for this purpose it is run up and synchronised as usual on the a.c. side, but the d.c. side is left "open," and if the d.c. excitation is sufficiently increased by shunt regulation the a.c. side will supply leading wattless current. In this way it will be seen that motor-converters, which would otherwise be idle excepting at times of maximum load, can be used when desired as power factor improvers.

Standard motor converters for traction service are arranged to compound automatically from 500 volts at no load to 550 volts at full load. The power-factor is unity at about three-quarter load, and at larger loads the wattless current is leading, which has a favourable effect on the supply system. This feature is of special value where the central station supplies both traction and lighting systems, the primary voltage remaining steady in spite of fluctuating load upon the traction converters. The efficiency is noticeably high, especially at half and quarter loads. The freedom from liability to reversal of polarity, during starting up, and from "shorts" they are arranged as shown in Fig. 2, from which it will be seen that the d.c. terminals are connected to the positive and negative mains in the usual way, the middle wire, which can be earthed if necessary, being connected through a suitable change-over switch to the star-point of the a.c. rotor winding. The brush gear and slip-rings at the a.c. ends of three wire converters are exactly the same as in ordinary two-wire converters, it being unnecessary to make them of heavier section—although they have to deal with the out-of-balance current—since, when the change-over switch is connected to the middle wire and the slip-rings short-circuited, the whole of the slip-rings together with their brush gear carry the out-of-balance current. A three-wire motor-converter automatically balances the voltage, and with an out-of-balance current of as much as 50 per cent. of the full load current, the variation between the two halves usually does not exceed 1 per cent. of the voltage between the outers. With 20 per cent. out-of-balance current the voltage variation would be within one-half per cent.

Obituary Item

Mr. Duncan N. Miller, superintendent of the Hamilton Street Railway Company was recently killed in an automobile accident. Mr. Miller was driving and apparently lost control of the car which ran over a steep embankment.

The Shipshaw Plant of Price Bros & Co.

Two Turbine Units 3300 h. p., horizontal type, operating 2250 kva. generators — 600 foot tunnel and large surge tank.

Some seventy years ago, Mr. Wm. Price established his first sawmill in Chicoutimi and gradually acquired extensive timber limits in the Province of Quebec. This industry throve and gradually branched out until today in the third generation, Price Bros. & Company, Limited, represent one of the largest paper industries in Canada. Their new modern 150-ton per day paper mill is located at Kenogami, near Jonquiere, on the Aux Sables river. From this river they derive power to drive the pulp grinders and also generate 6,000 h.p. of electrical energy for motive purposes in the mills.

Not having sufficient power on this river, they later purchased the water power rights at Shipshaw Falls, located on the Shipshaw river some four miles from Kenogami. The Shipshaw river is fed from Lake Onatchaway which in turn

Exterior power-house, Shipshaw Falls

is fed from lakes and rivers from Height of Land in Labrador. These falls are located some two miles up from the point where the Shipshaw empties into the Saguenay river, which latter place is practically sea level.

The minimum flow of water is 600 feet per second and the working head is 91 feet with possible 95 feet by using flashboards on dam.

Active work started on this plant in the latter part of July, 1912, and the plant was in operation within ten months—a record construction period when the many adverse conditions are considered.

The layout of this plant presented many engineering difficulties. Instead of the usual open canal, the water is led from the head gates at the dam into the surge tank (shown in one of the photos herewith), through a tunnel 600 feet long, having an inside diameter of 14 feet. The minimum thickness of the concrete wall of this tunnel is 16 in., reinforced circumferentially with sixty pound rails placed 3 feet apart.

The surge tank is 48 feet in diameter having solid concrete walls 18 in. thick, reinforced horizontally and vertically by 1-in. x 1-in. reinforcing steel placed 6 inches apart.

Leading from the surge tank are the openings for the three penstocks, two of which are already installed. Here it is that the water is directly controlled. At the entrance to each penstock a butterfly valve is installed which is electrically operated and directly controlled from the power house by means of push buttons.

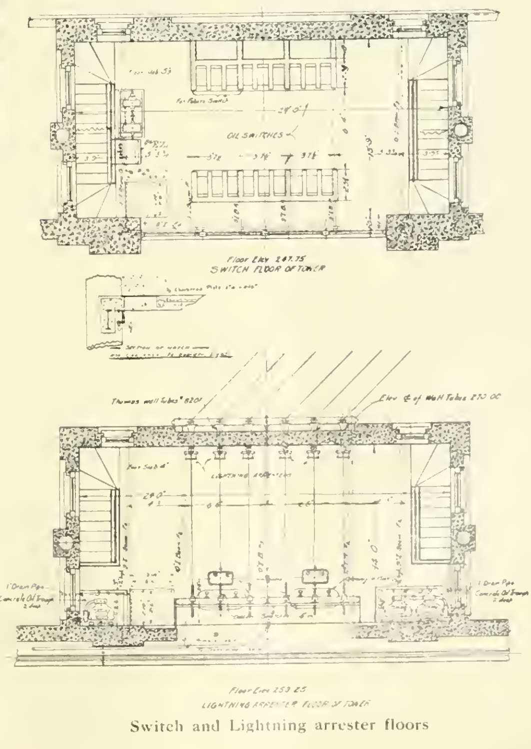
On the power house side of these valves, but still within the surge tank, there is installed, for each penstock, an air vent and inspection pipe 5 ft. by 2 ft., reaching vertically 11 feet above high water level.

Each penstock is 145 ft. long by 8 ft. diameter and built up of 3/8-in. boiler plate. Vent pipes and penstocks were installed by the John Inglis Company of Toronto.

The power house is 80 ft. long by 40 ft. wide, with foundations going down to bed rock. The power house is built entirely of concrete. An air duct ventilating chamber passes the full length of the generator foundations with openings into each generator pit. Provision is made for the high tension wiring by providing two galleries, while superintendent's office, machine shop room and lavatory are also provided.

A 35-ton electrically operated crane supplied by the Whiting Foundry and Equipment Company, runs the full length of the building.

Two turbines of the horizontal, double runner, central discharge, enclosed wheel case type of 3300 h.p. capacity, with 86 per cent. efficiency, are installed, as well as the



Switch and Lightning arrester floors

two smaller turbines for driving the d.c. exciters. The turbines and governors as well as the two butterfly gate valves and controlling apparatus therefor were manufactured and the installation superintended by the Allis-Chalmers-Bullock Company, of Montreal.

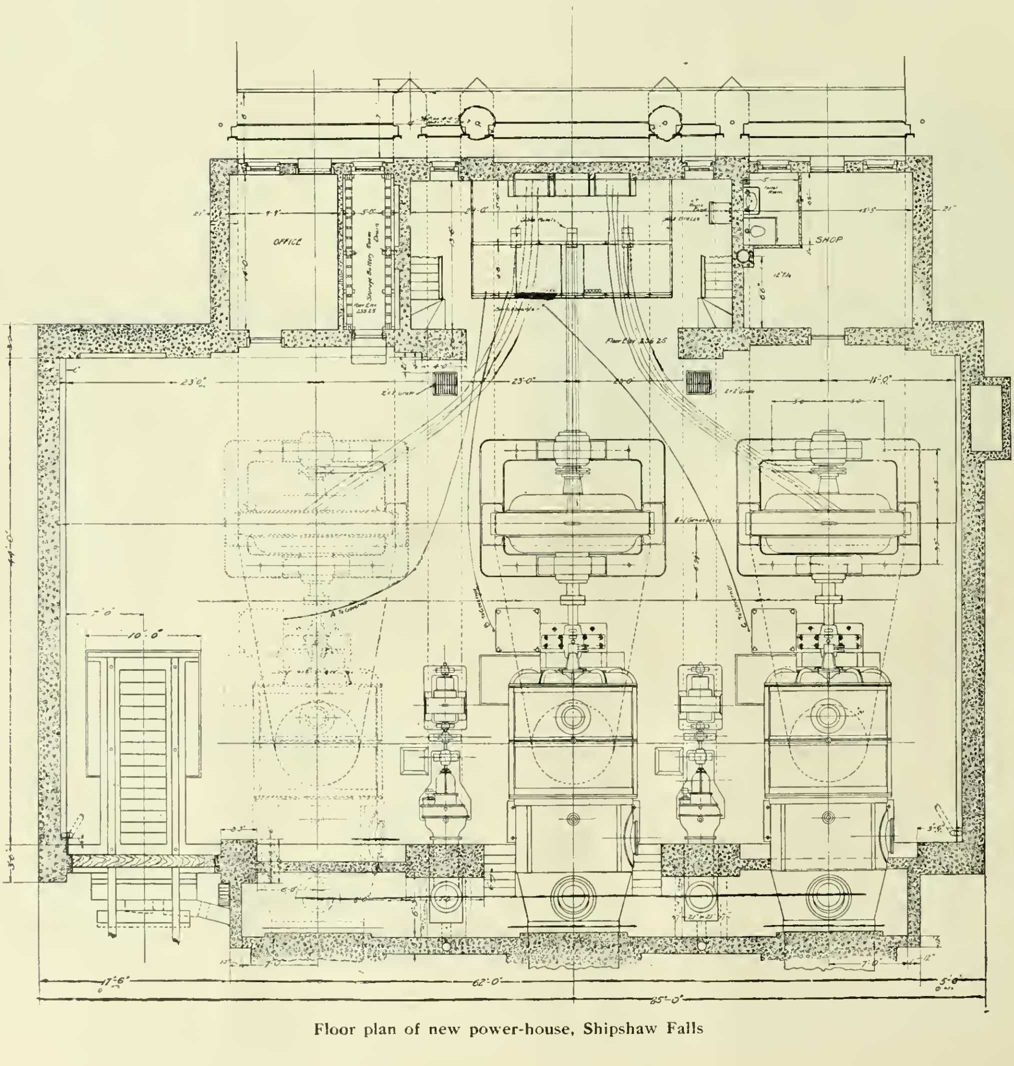
The electrical equipment consists of two a.c. generators rated at 2250 kv.a., 60 cycle, 300 r.p.m., 7,000 volt, giving an efficiency of 93.8 per cent. at full load and 80 per cent. p.f. The rotors of the generators are built up of 2-in. steel plates giving a fly-wheel effect of 400,000 pounds at radius of 1 foot. Excitation is provided for by two 120 kw., 900 r.p.m., 125 volt, d.c. exciters, either one of which is of sufficient capacity to excite the complete generating equipment of three units which will be the final total capacity of the station.

The switchboard is located in the bay level with the main floor and consists of nine panels of natural black, oil finished slate being designated as follows:— two line panels, one station lighting, two exciter, one Tirrill regulator, two for present installed generators and one blank panel for future generator, as well as two swinging end brackets for synchroscope and two a.c. voltmeters.

Provision is made for synchronizing this plant with the plant at Kenogami, where the generators are of the same voltage and characteristics as those installed here. To this end voltmeter receptacles and plugs together with synchronizing receptacles are installed in both power stations so that incoming voltage may be read and plants synchronized from either end.

On the first gallery are installed the five type E electrically operated, 3-phase oil circuit breakers controlled from their respective panels below. Here also are mounted the 7,000 volt busses, these being in duplicate with asbestos barriers between each phase. Six selector disconnecting switches, with asbestos barriers between each, are installed for use with each type E circuit breaker respectively.

A storage battery with normal rating of 80 amp. hours is installed to operate the oil switches and also, in case of emergency, to be used in opening or closing the main but-

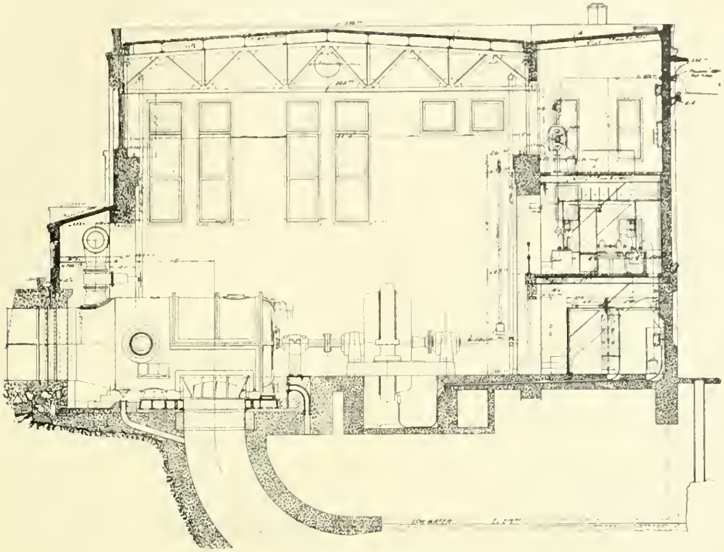


Floor plan of new power-house, Shipshaw Falls

terfly valves. This battery may be either charged from one of the exciters or from a small motor-generator set installed for the purpose.

On the top gallery are mounted the two sets of choke coils and multi-gap lightning arresters and here also provision is made for the outgoing line. Lead-covered cables work and provided with suitable reflectors. Heating of power house and surge tank is provided for by 220 volt electric heaters.

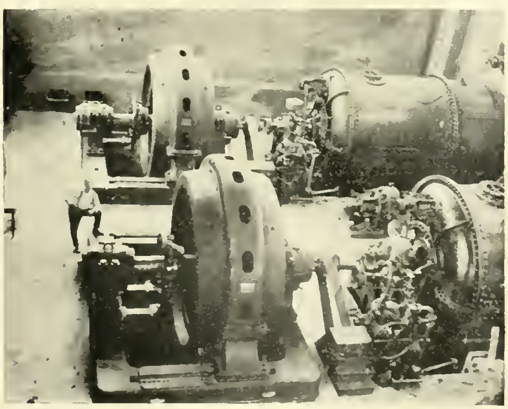
An electrically operated stop-log winch travels the full length of the dam and is supplied with power from the d.c. bus bars.



Sectional Elevation of Shipshaw Power Plant

with potheads are used for a.c. and d.c. generator leads as well as generator field leads. These pass through fibre ducts concealed in the floor. From the rear of the switchboard all high tension wiring is open work, number 0000, solid, soft drawn copper wire being used. The high tension wiring at rear of switchboard is protected by asbestos doors.

The transmission line consists of two three-phase lines of number 000 stranded copper wire mounted in the form of



Generators and Turbines—Shipshaw Falls

equilateral triangles on a single pole line. Two ground wires are strung overhead of each line respectively.

Ample power house lighting is provided by using 110 volt tungsten lamps, installed on the ceiling in open conduit

The complete electrical equipment was manufactured and installed by the Canadian Westinghouse Company of Hamilton.

Owing to the severe climatic conditions and heavy snowfall experienced in this northern locality, considerable difficulty was encountered in getting the machinery up from Chicoutimi, nine miles distant, into the power house. As it was, the manufacturers were obliged to ship all machinery completely knocked down and the machines were assembled on the job. Even then it was no uncommon sight to see an eight-ton piece on a sleigh, drawn by eight teams, stuck in a snow bank. This transportation was to a great extent solved when heavy four runner sleighs were adopted. The use of this latter type of sleigh would permit the outer runner cutting off the beaten track while the inside runner would support the load until firm track was regained.

Power for construction work was economically solved by transmitting electric power over the transmission lines from Kenogami at 7,000 volts. It was stepped down in a temporarily equipped substation and used to drive electric motors supplying power for air compressor, pumps, hoists, winches, stone crusher and cement mixers, as well as for lighting purposes.

Mr. R. S. Kelsch, Montreal, was consulting engineer for the entire installation and was represented on the ground by Mr. George Lewis as superintendent of construction. All work was done by day labor.

Work for, not against, the organization that pays you. The strength of an organization can scarcely surpass that of the individuals that make it. There are three principles that pay big dividends—punctuality, courtesy and industry.

Mountain-Grade Railway Electrification

A very complete discussion of the relative costs and operating expenses for steam and electric locomotives

By Mr. H. M. Hobart*

A keen interest is at present being taken in the electrification of mountain-grade divisions of main-line railways in the Western States of this country. In several concrete instances, careful estimates have demonstrated that the operating economies which can be effected by superseding with electric locomotives the steam locomotices on such railways are enormous, and are indeed, of such amounts as to defray in a very few years the initial outlay for substations, for feeders and contact-conductors, and for electr'c locomotives.

A chief factor contributing to this result relates to the very low cost at which the large hydro-electric supply companies in the West can profitably sell electricity for operating synchronous motors in substations. A considerable proportion of the present load of these hydro-electric undertakings consists in induction motors. The large lagging component of the current consumed by induction motors involves capital and operating costs which are very much in excess of the corresponding costs of supplying equal amounts of energy at unity power factor. Synchronous motors may with advantage be so operated as to consume a current with a large leading component. It often pays an electricity-supply company to go to the expense of purchasing and installing large synchronous motors for the express and exclusive purpose of running them idle and with high excitation, simply to neutralize the lagging component of the current consumed by the induction motor load. If the electricity-supply companies can find customers who will take upon themselves the expense of purchasing such synchronous motors and who will so operate them from the electricity-supply companies' system as to neutralize the undesirable lagging component, then they are spared the necessity of themselves incurring this capital outlay for improving the conditions on their system. Although the electricity-supply companies may not be able to satisfy themselves that they can equitably pay the railway companies for operating synchronous motors from their systems, nevertheless it will be seen that exceptionally low prices, satisfactory to both parties to the transaction, should readily be agreed upon. The equitable price in such a case should be arrived at on the basis of debiting the railway company with the value of the energy delivered to the substations and crediting the railway company with the value to the supply company of the leading current drawn from the system by the over-excitation of the synchronous motors in the substations.

The electricity-supply companies' traditional objection to a railway load of the sparse character associated with the operation of mountain-grade divisions, has, in the past, related to its very poor load factor. But when it is understood that these Western hydroelectric companies already have enormous loads connected to their systems, it will be seen that the fluctuations of a couple of thousand kilowatts, more or less, imposed by the intermittent operation of a few freight trains, is not a factor of consequence, especially since it does not affect the leading component of the current consumed by the synchronous motors.

Engineers have in the past usually erred in their ideas regarding the order of magnitude of a railway load. The present electricity-supply companies distributed about the country could often handle the load corresponding to relatively large railway undertakings without incurring the expense of any very considerable extensions of their generating and transmitting installations.

Let us illustrate this point by the case of the Butte, Anaconda and Pacific Railway, which is electrifying 90 miles of track with the 2400-volt system. The equipment comprises 15 freight locomotives and two passenger locomotives, each of these 17 locomotives weighing 80 tons. Although the undertaking involves transporting annually five million tons of ore over a distance of some 26 miles, the quantity of electricity which wil lbe consumed annually at the substations will only be of the order of less than 20 million kw.hr. A single 5000 kw. turbo-generator with a total weight (including steam-turbine, generator and their common base and bearings) of only some 115 tons, often turns out this quantity of electricity in the course of a year. Only two substations (26 miles apart) are required for the undertaking, and each substation contains only two motor-generator sets, each set having a rated capacity of 1,000 kw. and an ample overload capacity to carry 3,000 kw. for 5 minutes at intervals. The four motor-generator sets only aggregate a total weight of some (4 × 45) 180 tons. The only items of large consequence involved in the electrification of this undertaking are, on the one hand, the 17 locomotives, and, on the other hand, the provision of the overhead contact line, the track bonding and the positive and negative feeders.

Weight Distribution

Trailing loads of 3,400 tons[1] will be hauled by two of these 80-ton locomotives (operating as a single machine) from Butte to Anaconda over a route with a maximum grade of 0.3 per cent. For such a case we no longer have the condition which, as we have seen, so greatly affects the economy of the express-passenger proposition, namely, that the weight and friction of the locomotive constitute considerable percentages of the weight and friction of the entire train. Taking the friction of the trailing load (with reasonable allowance for curves), at 4 pounds per ton, the draw-bar-pull on a 0.3 per cent. grade amounts to

$$(0.3 \times 20 + 4) \times 3{,}400 = 34{,}000 \text{ lb.}$$

If the corresponding speed is 14 miles per hour, the power at the draw-bar is

$$\frac{14 \times 5{,}280 \times 34{,}000}{60 \times 33{,}000} = 1{,}270 \text{ h.p.}$$

Under such conditions the input to the locomotives is about

$$\frac{3{,}560 \times 1{,}270 \times 0.746}{3{,}400 \times 0.87} = 1{,}140 \text{ kw.}$$

At 2,400 volts, this corresponds to a current of about

$$\frac{1{,}140{,}000}{2{,}400} = 480 \text{ amperes}$$

or 240 amperes per locomotive. Considerably greater currents will be drawn from the line when starting and accelerating. When returning empty, the trailing load of some 1,000 tons must be drawn up maximum grade of one per cent. The tractive effort for the empty cars will be 8 lb. per ton and the draw bar pull will then be

*Extracted from a paper before the A.I.E.E.

[1]Many trains will be so much lighter as to require the use of only one 80-ton locomotive. Single locomotives will also be employed in the yards and at various points of the system as switchers and pushers.

$$28 \times 1{,}000 = 28{,}000 \text{ lb.}$$

Obviously, even for the heavy freight service on this mountain division, the use of two of these 80-ton locomotives will give a very wide margin of excess capacity. Each 80-ton locomotive will develop continuously a tractive effort of 25,000 lb. at 15 miles per hour. For the 160-ton combination this corresponds to a continuously sustained draw bar output of

$$\frac{15 \times 5{,}280 \times 2 \times 25{,}000}{60 \times 33{,}000} = 2{,}000 \text{ h.p.}$$

On a level track, higher speeds will be available. At starting, the 160-ton combination will provide a tractive effort of

$$160 \times 2{,}000 \times 0.25 = 80{,}000 \text{ lb.}$$

for a 25 per cent. coefficient of adhesion

$$\text{or } 160 \times 2{,}000 \times 0.30 = 96{,}000 \text{ lb.}$$

for a 30 per cent. coefficient of adhesion.

This tractive effort can also be provided by a Mallet locomotive with 160 tons on drivers. The engine and tender will, however, weigh some 250 tons and the weight on each of the six driven axles amounts to

$$\frac{160 \times 2{,}000}{6} = 53{,}300 \text{ lb.}$$

as against a weight of only

$$\frac{160 \times 2{,}000}{8} = 40{,}000 \text{ lb.}$$

on each of the eight driven axles of the electric locomotive. Obviously on the single score of the distribution of weight, the track conditions are distinctly less severe with the electrical alternative. There is also the important advantage, in the case of the electric locomotive, that the torque is uniform and in striking contrast with the pulsating torque of the steam locomotive.

But the essential contrast as regards relative capacities is brought to light when we state that the Mallett locomotive, when burning lignite of a calorific value of some 11,000 B.t.u per pound, can, when exerting a drawbar pull of 60,000 lb., only maintain a sustained speed of some 6.5 miles per hour. Under these conditions the locomotive will be consuming about 7,500 lb. of coal per hour, and will be developing

$$\frac{6.5 \times 5{,}280 \times 60{,}000}{60 \times 33{,}000} = 1{,}040 \text{ drawbar h.p.}$$

If the 250-ton Mallet locomotive is hauling a 3,400-ton train, then the indicated horse-power will be about

$$\frac{3{,}650 \times 1{,}040}{3{,}400 \times 0.75} = 1{,}500 \text{ i.h.p.}$$

The calorific value of the lignite employed as fuel may also be expressed as

$$\frac{11{,}000}{2{,}545} = 4.32 \text{ h.p.-hr per pound}$$

Thus the efficiency from the coal to the cylinders is

$$\frac{1{,}500 \times 100}{7{,}500 \times 4.32} = 4.63 \text{ per cent.}$$

This efficiency estimate is on the basis of a fuel consumption of

$$\frac{7{,}500}{1{,}500} = 5.00 \text{ lb. of lignite per i.h.p.-hr.}$$

The efficiency from the coal to the drawbar is

$$\frac{1.040}{1.500} \times 4.63 = 3.22 \text{ per cent.}$$

The coal consumption per drawbar h.p.-hr is

$$\frac{4.63}{3.22} \times 5.00 = 7.20 \text{ lb. per drawbar h.p. hr.}$$

When, however, we take into account the coal wastefully burned during the large part of the time during which the steam locomotive is standing still, we arrive (for mountain-grade freight service), at figures of the order of from 10 to 12 or more pounds of lignite burned per drawbar h.p.-hr. On the basis of 10 lb. per drawbar h.p.-hr. the efficiency from the coal to the drawbar works out at

$$\frac{7.20}{10} \times 3.22 = 2.32 \text{ per cent.}$$

Even when, as will usually be the case in the West, the electric proposition involves obtaining energy from hydro-electric undertakings, it is nevertheless instructive to give close attention to these efficiency and coal consumption figures, and to contrast them with the results which may be obtained with the equivalent electricity generating station in which coal fuel is employed. It has already been stated that in such a case, some 6.5 per cent. of the energy in the coal burned at the generating station is delivered at the rims of the drivers. We have now seen that for the freight service in question, an electric locomotive weighing 160 tons, when compared with a steam locomotive weighing with tender some 250 tons, yields at least as great a drawbar pull at starting, since with the same weight on drivers it replaces a pulsating torque with a constant torque. Furthermore it can develop this drawbar pull at 14 miles per hour as against less than half this speed for the steam locomotive.

Smaller Crew Necessary

The electric locomotive requires to be manned only by one engineer, although, as a precautionary measure, an assistant engineer accompanies him on the locomotive. But when, as in the instance we have considered, a Mallet is burning 7,500 lb. of coal per hour, it is considered that it is beyond the capacity of a single fireman, and for sustained efforts of this amount, two firemen should be provided. In other words, in order to work up to a consumption of 7,500 lb. of coal per hour (corresponding to a speed of 6.5 miles per hour with a drawbar pull of 60,000 lb. making 1,500 i.h.p.) two firemen are necessary if these conditions of speed and drawbar pull are sustained for considerable periods. Thus a crew of three men are required on the steam locomotive when only 1,500 i.h.p. are developed, while on the electric locomotive just one man is actually necessary (although two are provided for the reasons stated), even when the locomotive is developing over 2,000 h.p.

Finally, as regards capital outlay and maintenance. Electric locomotives with the axles driven through gears cost a matter of some $450 per ton and the outlay for repairs and maintenance runs to some 4 cents per mile per 100 tons of weight of locomotive. The outlay for repairs and maintenance of steam locomotives is about of the order of 10 cents per mile per 100 tons of weight and since steam locomotives are inherently incapable of the mileage per annum which can be obtained from electric locomotives, then notwithstanding that steam locomotives cost considerably less than half as much per ton of weight, the charges per locomotive-mile for repairs and maintenance, plus interest, taxes, insurance and amortization are inherently decidedly greater for the steam locomotive than for the electric locomotive. Electric railway engineers are satisfied that these are conservative ratios. That the values which will ultimately be estab-

-This ratio of costs is only in small part due to any inherently greater cost per ton in the case of electric locomotives. It is chiefly due to the fact that whereas several thousands of steam locomotives are built every year, there are not more than [illegible] of 1000 electric locomotives in existence, and only 100 to 200 are built annually. The number of steam locomotives in the United States, United Kingdom, Germany and France aggregates over 100,000.

lished will be still more favorable to the electric locomotive will only slowly be demonstrated in practice, largely for the reason that conventional methods of operating railways have been so evolved as to conform with the properties and limitations of the steam locomotive. Emancipation from these limitations will not immediately be followed by a revolution in methods of operating railways. On the contrary, the electric locomotive will for some time to come be compelled to conform to the conventions of the past. Advantage will only gradually be taken of the electric locomotive's inherently greater capacity as regards speed (in the case of freight haulage) for a given drawbar pull. It will be some considerable time before methods will so be modified that, in virtue of its greater capacity for speed in freight haulage, and in virtue of freedom from the necessity of devoting a large percentage of time to overhauling it and taking it out of service for repairs[3], 50 per cent. or even 100 per cent. more mileage per annum will be obtained from the electric locomotive than has been found expedient with its steam predecessor. Most of the present overtime expenses will be eliminated with electric operation and this in itself will effect a large saving in crew expense.

Electrification of a 96-mile Division

Let us now consider the electrification of a link in a main-line railway, which consists in a mountain-grade division 96 miles long. At certain seasons of the year there is experienced at this link, a congestion of freight traffic of so severe a nature that it becomes necessary to divert to other routes of much greater length a large per centage of the available freight.[4] The division is single-tracked with 15 sidings at an average distance of six miles apart, thus dividing the 96 miles into sixteen sections of varying length but averaging six miles each. The character of the route is such that double-tracking would involve enormous expense. This is often the case on mountain-grade divisions.

The trains negotiate an altitude of 3,800 ft. in 48 miles and return to the original level in the remaining 48 miles. Thus the average gradient is

$$\frac{3,800 \times 100}{48 \times 5,280} = 1.5 \text{ per cent.}$$

The ruling gradient is 2.2 per cent. There are occasional 2.5 per cent. gradients but these are so short that they may be dealt with as "momentum gradients" and are not determinants in arriving at the correct powering of the trains.

It is proposed that electric locomotives shall carry over this division trains of weight ranging from 900 to 1,800 tons (exclusive of the weights of the locomotives), and that while ascending, the average speed between stops shall be 12 miles per hour. Where the grade is in excess of the average value of 1.5 per cent., the speed will be less than 12 miles per hour, and for the gradients of less than 1.5 per cent. the speed will be in excess of 12 miles per hour. The range of variation will, however, be only of the order of from 9 to 15 miles per hour.[5] Ascending trains will be operated over the main track, and the number of stops will be reduced to a minimum. Descending trains will be operated at slightly higher speeds in order that they may be out of the way in the sidings when the ascending train arrives. Obviously on the basis of an average speed of 12 miles per hour, the 96-mile journey would require 8 hours were the ascending train to make no stops. On this admittedly theoretical hypothesis, and with trains in each direction simultaneously occupying alternate sections between sidings, the 96-mile division could contain simultaneously 8 trains travelling in each direction (or a total of 16 trains), and trains could be sent into the division from each end of the division at the rate of one per hour. Thus there could be 24 trains passed over the division in each direction per day. This leads us to the (theoretically) limiting capacity of

$$48 \times 96 = 4,600 \text{ train-miles per day.}$$

In practice, however, after making reasonable allowances of unequal distances between sidings, variations in speed due to varying grades and curves, delays at the terminals of the 96-mile division, inevitable stops even of the ascending trains, and other causes for irregularity, the practical limit of the capacity of the division may be taken as of the order of

$$(0.75 \times 48) \times 96 = 36 \times 96 = 3,460 \text{ train-miles per day.}$$

This is on the basis that there shall be only $(36/2 =)$ 18 trains instead of 24 in each direction per day.

Traffic of this intensity will, however, occur only during 100 days in the year. For the remaining 265 days, the freight to be transported will require only the equivalent of twenty-four 900-ton trains per day, or twelve 900-ton trains in each direction, whereas for the 100 days of dense traffic, the 36 trains per day will each represent 1,800 tons behind the drawbar.

Thus there will be transported annually over the division a total tonnage behind the drawbar, amounting to $100 \times 36 \times 1,800 + 265 \times 24 \times 900$[6] $= 6,500,000 + 5,700,000 = 12,200,000$ tons, or $96 \times 12,200,000 = 1,170,000,000$ ton-miles.

Making reasonable allowance for the weight of the cars and for empty and lightly-loaded cars, we may take one-half of this load behind the drawbar as revenue tonnage. The paying load will thus amount to 6,100,000 tons per annum or $96 \times 6,100,000 = 585,000,000$ ton-miles.

On the basis of an average rate of 0.75 cent per ton-mile, the gross receipts amount to $585,000,000 \times 0.0075 =$ \$4,390,000 per annum or \$45,600 per mile of railway.[7]

The requirements of the railway as regards number and size of locomotives must be based on the seasons of dense traffic. On the ruling grade of 2.2 per cent., an 1,800-ton train will require a drawbar pull of $(2.2 \times 20 + 8) \times 1,800 = 94,000$ lb.

Adding a further 36 per cent. in order to have a safe margin for increased journal friction in cold weather, for adverse winds and for severe curves, we arrive at the value of $1.36 \times 94,000 = 128,000$ lb. as the drawbar pull which should be available when dealing with 1,800-ton trains on this division. Providing a locomotive at each end of the train then each of these two locomotives will require to have sufficient reserve capacity for exerting a draw bar pull, or push, of

$$\frac{128,000}{2} = 64,000 \text{ lb.}$$

On the basis of a coefficient of adhesion of 0.20, each locomotive must have a weight on drivers of

$$\frac{64,000}{0.20 \times 2,000} = 160 \text{ tons}$$

Thus so far as relates to the provision of the required tractive effort, the 160-ton Butte locomotives already described in this paper, are appropriate for use on this 96-mile mountain-grade division.

The drawbar pull, when accelerating from rest (at the rate of one-tenth of a mile per hour per second) on the aver-

[3]While a comparatively short run necessitates that the steam locomotive temporarily be withdrawn from service for several hours for adjustments, cleaning and other attentions, no such limitations obtain in the case of the electric locomotive. Moreover it can be arranged that the engineer and his assistant shall relieve one another at frequent intervals, thus maintaining their strength and alertness to a degree quite impossible for the engineer and fireman constituting the crew of a steam locomotive.

[4]While the extent of the freight congestion assumed in this example is doubtless extreme, the rapidly expanding freight business of the country is leading to conditions of this order of seriousness.

[5]A few passenger trains will be sent over the division every day. But to simplify the investigation, it will be assumed that these are taken into account by their equivalent in freight traffic.

[6]It is shown later that the 1800-ton trains will require two locomotives and the 900-ton trains, one locomotive, consequently the annual locomotive-mileage is equal to $96 \times 100 \times 36 \times 2 + 96 \times 265 \times 24 \times 1 = 690,000 + 610,000 = 1,300,000$.

[7]It is recognized that this is a high figure, but it is consistent with the hypothesis of a congested link in an extensive railway system.

age gradient or 1.5 per cent., will be (1.5 × 20 + 10 + 10) × 1,800 = 90,000 lb. of only 69 per cent. of the maximum drawbar pull (128,000 lb.), available with a coefficient of adhesion of 0.20. When desirable, an acceleration of over a quarter of a mile per hour per second may be imparted to an 1,800-ton train on the average grade.

When working the line to its utmost capacity (i.e., with a descending train in every other length between sidings and an ascending train in each intermediate length between sidings, each train having a weight, exclusive of locomotives, of 1,800 tons) there would be simultaneously traversing the division 16 trains and 32 locomotives. It has already been explained that practical limitations will cut this down, either as regards the number of trains simultaneously present in the division or as regards the maintenance of the journey speed of 12 miles per hour for the 96-mile run. The actual shortage will be due partly to each of these two factors. With due allowance for additional locomotives to be available in making up trains at the terminals before entering the 96-mile division, and for spare locomotives, there should be provided a total equipment of 48 locomotives of 160 tons each.[8] This total number of locomotives is determined upon to meet the requirements of the 100 days of dense traffic. A considerable percentage of the 48 locomotives will be in excess of the requirements of the remaining 265 days of the year and will be enforcedly idle.

When handling an 1,800-ton train at a speed of 12 miles per hour on a 1.5 per cent. grade, we have

$$\frac{12 \times 5{,}280 \times 90{,}000}{60 \times 33{,}000} = 2{,}880 \text{ h.p. at the drawbar}$$

This will be subdivided between the two 160-ton locomotives, and each will deliver 1,440 h.p. at the drawbar, or

$$\frac{900 + 160}{900} \times 1{,}440 = 1{,}700 \text{ h.p.}$$

at the rims of the drivers.

Each locomotive has eight motors (one on each of the eight driven axles); consequently the output per motor when ascending the 1.5 per cent. grade at 12 miles per hour, is 1,700/8 = 213 h.p.

Since this output of 213 h.p. is the average load, the work is seen to be well within the capacity of the equipment on the Butte locomotives, for on these locomotives each motor has a continuous capacity of 250 h.p. when cooled by the forced circulation of air through it.

In making up an estimate of the total annual traffic, we have arrived at the figure af 12,200,000 tons as the weight behind the drawbar passing annually over the division. Since we employ a 160-ton locomotive for every 900 tons, we shall have

$$\frac{12{,}200{,}000}{900} = 13{,}600 \text{ locomotive-journeys}$$

over the division per annum.

$$\text{or} \quad \frac{13{,}600}{48} = 284 \text{ journeys per locomotive.}$$

Thus as an average for each one of the 48 locomotives we have a performance of 96 × 284 = 27,200 miles per annum.[9]

This is not to be taken as indicating an average mileage of 27,200/12 = 2,260 miles per locomotive for each of the 12 months in the year. On the contrary, during the months of heavy traffic this will be greatly exceeded and during the months of light traffic a considerable proportion of the locomotive equipment will be idle and the average mileage per month per locomotive will fall greatly below 2,260 miles.

At the speed of 12 miles per hour (96/12 =) 8 hours would be occupied by the journey, and each locomotive would spend 286 × 8 = 2,288 hours per annum on the 96-mile division. But what with the decreased speed due to delays and the large amount of time occupied at terminals in making up trains, each locomotive would be in service with its crew for 1.5 × 2,288 = 3,440 hours. On the basis of eight-hour shifts and two men per crew, and an average wage of \$6.00[10] per day, the wages per locomotive amount to

$$\frac{3{,}440}{8} \times 2 \times 6.00 = \$5{,}150 \text{ per annum}$$

$$\text{or} \quad \frac{515{,}000}{27200} = 18.9 \text{ cent. per locomotive-mile}$$

Repairs and maintenance per locomotive amount to 0.04 × 1.6 × 27,200 = \$1,740 per annum or 4 × 1.6 = 6.4 cent per locomotive-mile.

On the rough basis of \$450 per ton, we may take the price of each locomotive as 160 × 450 = \$72,000.

The 48 locomotives run to a total initial outlay of 48 × 72,000 = \$3,460,000.

Taking interest, taxes, insurance and amortization as aggregating 12.6 per cent. on the investment for locomotives, these charges for each locomotive amount to 72,000 × 0.126 = \$9,060 per annum.

(This is on the basis of interest at 5 per cent., taxes 1.5 per cent., insurance 1.5 per cent., and a life of 15 years).

Thus we have, per electric locomotive per annum

I.—Wages of loco- crews	\$5,150
II.—Repairs and maintenance	1,740
III.—Interest, taxes, insurance, amortization	9,060
Total of above three items	\$15,950

For the 48 locomotives, this comes to a total of

48 × 15,950 = \$766,000.

Cost of Electric Energy

Now let us estimate the amount of electricity consumed by the locomotives. On the ascent, the power averages 2,880 h.p. at the drawbar or 3,400 h.p. from the motors.

The average consumption by the locomotives works out at

$$\frac{3{,}400 \times 0.746}{0.87} = 2{,}920 \text{ kw.}$$

During the ascent, electricity is drawn from the line only during (48/12 =) 4 hours, notwithstanding that the ascent is only accomplished in a greater time than this.

The energy consumed during the ascent is

4 × 2,920 = 11,700 kw. hr.

No return of energy to the line will be credited to the locomotives during the descent; on the contrary, an allowance of 500 kw. hr. will be made for occasional applications of power.

Energy consumed by locomotives during descent = 500 kw. hr.

Total consumption of energy by locomotives for 96-mile journey with 1,800-ton train,

11,700 + 500 = 12,200 kw. hr.

[8] With the mean value of 28 locomotives (14 trains) simultaneously occupying the 96-mile section, there remains (48 − 28) = 20 locomotives. With four undergoing repairs, we have 16 available at terminii, 8 at each end. Since these locomotives are double-ended, there will be much less time occupied than with steam locomotives in making up trains in readiness to be sent into the division.

[9] In the footnote No. 6, we have already arrived at the figure of 1,300,000 locomotive-miles per annum. We have 1,300,000/48 = 27,200 miles per locomotive per annum, thus checking the above result in the body of the text.

[10] The crew of each locomotive will consist of an engineer and his mate. The latter accompanies the engineer on general principles relating to safety in the event that the engineer should be incapacitated from any cause. The engineer will receive a higher wage than this average of \$6.00 for the crew, and the mate will receive less than this average. The average figure of \$6.00 is high when taken in connection with the schedules at present in force, but its employment in this comparison is consistent with the purpose to favor steam-locomotive methods at all points where the reasonableness of the assumptions could be questioned.

For the 900-ton trains, the consumption per journey will be

$$\frac{12,200}{2} = 6,100 \text{ kw.-hr.}$$

There are $100 \times 36 = 3,600$ journeys per annum with 1,800-ton trains and $265 \times 24 = 6,360$ journeys per annum with 900-ton trains.

Thus the total consumption at the locomotive is

$$3,600 \times 12,200 + 6,360 \times 6,100 = 44,000,000 + 39,000,000 = 83,000,000 \text{ kw.-hr. per annum.}$$

Increasing this by 25 per cent. (i.e., by 21,000,000 kw.-hr.), to 104,000,000 kw.-hr. per annum to allow for terminal movements and for heating of locomotives and as a margin of safety, and taking at 0.93 the annual efficiency from the substations to the trains, we obtain for the output from the substations.

$$\frac{104}{0.93} = 112 \text{ million kw.-hr. per annum.}$$

The annual overall efficiency of the substations may be taken 78 per cent. Consequently the input to the substations is

$$\frac{112}{0.78} = 144 \text{ million kw.-hr. per annum.}$$

On the basis of a price as delivered to the substations, of 0.70 cent. per kw.-hr. the outlay for electricity is

$$144,000,000 \times 0.0070 = \$1,010,000 \text{ per annum.}$$

Per locomotive, this works out at

$$\frac{1,010,000}{48} = \$21,000$$

or

$$\frac{2,100,000}{27,200} = 78 \text{ cents per locomotive mile}$$

As to the overhead contact line, the rail bonding and the feeder copper, these will be covered liberally by an outlay of \$8,500 per mile. Allowing for sidings, the total outlay will be \$900,000.

Finally, there will be required four substations, each for an annual output of 28,000,000 kw.-hr.

On the basis of a load factor of 0.25, the maximum load on each substation will be

$$\frac{28,000,000}{8,750 \times 0.25} = 12,800 \text{ kw.}$$

The average load per substation will be only some

$$\frac{28,000,000}{8,750} = 3,200 \text{ kw.}$$

These substations will cost, complete, with step-down transformers and motor generators, some \$160,000 per substation or \$640,000 for the four substations.

Taking interest, maintenance, taxes, insurance, amortization, and labor for attendants, and linemen, as amounting to 16 per cent.[11] on this outlay of $(900,000 + 640,000) = \$1,540,000$ we arrive at a charge of

$$(0.16 \times 1,540,000 =)\ \$246,000 \text{ per annum}$$

or

$$\frac{246,000}{48} = \$5,130 \text{ per locomotive,}$$

or

$$\frac{513,000}{27,200} = 18.8 \text{ cents per locomotive mile.}$$

Thus for those annual outlays which are other for electric working than they are for steam working, we have:

	Per annum
Loco. wages, repairs and maintenance, interest taxes, insurance, amortization	\$ 766,000
Electricity	1,010,000
Substations and distributing system	246,000
Total	\$2,022,000

Now how does the case stand with steam? Let us assume that a 250-ton Mallet locomotive can handle a load of 600 tons behind the draw bar over this division with the same speed when in motion, as the 160-ton electric locomotive with its 900-ton load.[12] Then when, as at times of densest traffic, it is desired to carry freight in 1,800-ton trains, we shall require three 250-ton Mallets as against two 160-ton electric locomotives.

The average load at the drawbar, if equally subdivided amongst the three Mallets is

$$\frac{2,880}{3} = 960 \text{ h.p. per Mallet}$$

The drawbar pull is equal to

$$\frac{960 \times 33,000 \times 60}{12 \times 5,280} = 30,000 \text{ lb.}$$

This corresponds to an output from the cylinders of

$$\frac{(600 + 250) \times 960}{600 \times 0.75} = 1810 \text{ i.h.p.}$$

The fuel will be Western lignite of a calorific value of 11,000 B.t.u. (4.32 h.p.-hr.) per pound and the consumption will be five lb. per i.h.p.

The coal consumption for a speed of 12 miles per hr. and for 600 tons behind the drawbar, thus amounts to

$$\frac{1,810 \times 5}{12} = 755 \text{ lb. per locomotive-mile}$$

But this result is arrived at on the basis that there is no wasteful consumption during stops. Unlike the electric locomotive, however, several stops will be necessary for taking on water and for coaling, and the consumption during the ascent will be increased to at least 850 lb. per locomotive-mile, or

$$48 \times 850 = 40,800 \text{ lb. for the ascent.}$$

The descent will occupy some 5 to 7 hours. While the power required for propulsion will be negligible for most of the descent, nevertheless, steam must be maintained in the boilers, and also, owing to the high frictional-resistance of Mallet engines, power will be required for all grades materially lower than the average value of 1.5 per cent. Let us take the coal consumption as 400 lb. per hour, or $6 \times 400 = 2,400$ lb. for the 48-mile descent.

Thus the total coal consumption for the locomotive for the 96-mile journey, comes to

$$40,800 + 2,400 = 43,200 \text{ lb.}$$

This should be increased by 20 per cent. to cover the coal burned by the switching engines and also by the Mallets during terminal movements before entering and after leaving the 96-mile division, bringing the total to

$$1.20 \times 43,200 = 52,000 \text{ lb.} = 26 \text{ tons}$$

This is an average of

[11]The criticism may be raised that this \$246,000 should be considered in detail. To do so would only introduce uninteresting calculations. The item is relatively so small that it can consistently be dismissed without further comment than to point out that it includes an allowance of some \$50,000 for wages of substation attendants, inspectors and linemen.

[12]This is crediting the Mallets with a higher speed for such loads than they can maintain. Nevertheless it is desired to err on the side of favoring the steam locomotive whenever there is room for divergence of opinion.

$$\frac{52,000}{96} = 540 \text{ lb. per locomotive-mile}$$

for the 96-mile journey.

At $2.40 per ton, we have a full cost of

$$\frac{540}{2,000} \times 240 = 65 \text{ cents per locomotive mile}$$

Of course it is to be understood that the terminal operations are not executed by Mallets but by switching locomotives. But to simplify the calculations, the equivalent outlay is taken in terms of Mallets.

Attention must now be drawn to the consideration that with the delays inherent to steam locomotive operation, even on the favorable assumption that the speed with three 250-ton steam locomotives and an 1,800-ton train may, when running, be taken equal to the speed of two 160-ton electric locomotives and an 1,800-ton train, nevertheless, the running time for the 96-mile journey, (together with the increased time consumed in making up trains at terminals with single-ended and cumbersome steam switching engines as compared with double-ended and simple electric locomotives), will certainly be at least 50 per cent. greater. Thus for the 100 days of dense traffic when the division is worked to its utmost capacity, the train mileage is cut down to two-thirds of that obtained with electric operation. The limiting capacity of the line is thus reduced to

$$\frac{2}{3} \times 6,500,000 + 5,700,000 = 4,300,000 + 5,700,00$$
$$= 10,000,000 \text{ tons}$$

or $96 \times 10,000,000 = 960,000,000$ ton-miles

Again taking one-half as revenue load and crediting it with an average rate of 0.75 cent per ton-mile we ascertain the gross receipts to be

$$480,000,000 \times 0.0075 = \$3,600,000 \text{ per annum.}$$
$$\$37,500 \text{ per mile of railway.}$$

We have seen that for 600 tons behind the drawbar of each locomotive, the coal consumption to be debited to the entire journey works out at 540 lb. per locomotive mile.

This is

$$\frac{540}{300} = 1.80 \text{ lb. per revenue ton-mile,}$$

or

$$\frac{1.80}{2,000} \times 480,000,000 = 432,000 \text{ tons per annum}$$

At $2.40 per ton, the annual outlay for fuel amounts to

$$2.40 \times 432,000 = \$1,040,000.$$

The large amount of time required for cleaning, overhauling, repairing, adjusting and generally looking after the welfare of the steam locomotives renders it very liberal to credit each steam locomotive with an annual performance of

$$\frac{27,200}{1.50} = 18,100 \text{ miles}[13]$$

as against each electric locomotive's 27,200 miles per annum.

On the other hand during the 265 days of light traffic it will be fair to estimate that one steam locomotive shall haul a 900-ton train at a slower speed, instead of hauling a 600-ton train at the higher speed at which an electric locomotive hauls a 900-ton train. Since during these 265 days the line is not worked up to its physical limitations, the disadvantage of this plan is chiefly confined to the greater outlay for wages per locomotive-mile. No greater outlay for wages on this score will however be debited against the steam locomotive in this comparison.

The total steam locomotive mileage during the 100 days of heavy traffic is

$$96 \times 100 \times 24 \times 3 = 690,000 \text{ miles.}$$

During the remaining 265 days the steam locomotive mileage amounts to

$$96 \times 265 \times 24 \times 1 = 610,000 \text{ miles.}$$

The total steam locomotive mileage per annum is thus

$$690,000 + 610,000 = 1,300,000$$

Consequently we must provide

$$\frac{1,300,000}{18,100} = 72 \text{ Mallet locomotives}$$

Each weighs 250 tons and may be taken as costing $45,000.

Thus for the outlay for locomotives we have

$$72 \times 45,000 = \$3,240,000.$$

Allowing, as with the electric locomotives, 12.6 per cent. to cover interest, taxes, insurance and amortization, we arrive at an annual charge of

$$0.126 \times 45,000 = \$5,660 \text{ per locomotive}$$

or

$$\frac{566,000}{18,100} = 31.3 \text{ cents per locomotive-mile}$$

Each of the 72 locomotives makes

$$\frac{1,300,000}{96 \times 72} = 188 \text{ journeys per annum.}$$

Were only (96/12 =) 8.0 hours occupied by the 96-mile journey, then each locomotive would spend

$$188 \times 8 = 1,504 \text{ hours per annum}$$

on the 96-mile division. But there must be taken into account the decreased speed due to delays during the journey and also the great amount of time consumed in making up trains at terminals. This handicaps operations with single ended steam locomotives much more than with readily and promptly operated double-ended electric locomotives. It will be reasonable to assign to each steam locomotive an annual period of

$$2 \times 1,504 = 3,008 \text{ hours}$$

of service with its crew. The crew of the steam locomotive will consist of an engineer and a fireman working on eight hour shifts. On the basis of an average wage of $4.50 per day (the engineer receiving more, and the fireman less than this average), the outlay for wages for each steam locomotive, amounts to

$$\frac{3,008}{8} \times 2 \times 4.50 = \$3,380 \text{ per annum,}$$

or

$$\frac{338,000}{18,100} = 18.7 \text{ cent per locomotive mile}$$

It will be noted that in estimating the wages for each Mallet it is assumed that only one firemen will be required. However, we have already seen that 40,800 lb. of coal will be burned during the 48 mile ascent. If this ascent is accomplished in 5 hours, the coal consumption amounts to 8,200 lb. per hour, if in 6 hours, 6,800 lb. per hour. It is often maintained that two firemen should be provided when it is required to fire such great hourly quantities of coal.

Repairs and maintenance per locomotive amount to

$$0.10 \times 2.5 \times 18,100 = \$4,250 \text{ per annum}$$

(This is on the basis of $10 \times 2.5 = 25$ cents per locomotive mile).

Thus per steam locomotive per annum we have

	Per annum
1.—Wage of locomotive crews	$3,380

[13]This works out at an average of 18,100 / 365 = 50 miles per day averaged over the entire year. This figure is higher than that for any Mallets of which I have records, when operating on severe mountain-grade divisions.

II.—Repairs and maintenance	4,250
III.—Interest, taxes, insurance, amortization	5,660
Total of above three items	$13,290

For the 72 locomotives we have

$$72 \times 13,290 = \$956,000.$$

Bringing together the annual outlays which should be compared with those previously set forth as relating to equivalent operation by electricity we have

	Per annum
Locomotive wages, repairs, maintenance, interest, taxes, insurance and amortization	$ 956,000
Coal	1,040,000
	$1,996,000

But, whereas the electrical outlay of $2,022,000 per annum was associated with a revenue of $4,390,000 per annum leaving a difference of $2,368,000 per annum to be applied to the outlays common to both systems and to reserves, the corresponding steam outlay of $1,996,000 per annum is associated with the reduced revenue of only $3,600,000 per annum leaving a difference of only $1,604,000 to be applied to residual outlays and to reserves.

$$\frac{1,604,000}{2,368,000} = 0.68$$

Thus the residual amount with steam is only 68 per cent. of that with electricity.

It will be agreed that the correct basis for estimating the commercial results to accrue from electrical operation is to compare all those items which are affected by the use of electricity instead of steam. This is, however, inconsistent with the retention of the forms which have become customary in analyzing the results of steam operation. Consequently, as of probable interest, the locomotive operating expenses per locomotive mile are tabulated below.

	Operating expense in cents per locomotive mile. Steam locomotives	Electric locomotives
Fuel	65.0	0
Electricity	0	78.0
Repairs	20.0	5.6
Wages	18.7	18.9
Engine house expenses	3.5	0
Lubricants	0.9	0.5
Stores	0.6	0.3
	108.7	103.3

These figures only apply to the particular 96-mile mountain division which has constituted the subject of our analysis and to the particular prices employed for coal ($2.40 per ton) and electricity (0.70 cent per kw.-hr.).

For the electric proposition there is an average load of 900 tons behind the drawbar for every electric locomotive. But from the data previously given we see that the average load behind the drawbar for the steam locomotive is only

$$\frac{960,000,000}{1,300,000} = 740 \text{ tons}$$

Consequently to reduce the locomotive operating costs to comparable terms let us take as a standard of reference 100 tons behind the drawbar. We then have steam locomotive operating costs per mile

$$= \frac{108.7}{7.40} = 14.7 \text{ cents per 100 tons behind drawbar.}$$

Electric locomotive operating costs

$$= \frac{10.3}{900} = 11.6 \text{ cents per 100 tons behind drawbar}$$

Let us look at the costs per locomotive-mile, per total train-mile and per 100-ton-miles behind the drawbar for the 1,800-ton train which we have more particularly investigated. This required three 250-ton Mallets or two 160-ton electric locomotives, bringing up the total train weights in the two cases to ($3 \times 250 + 1,800 =$) 2,550 tons and ($2 \times 160 + 1,800 =$) 2,120 tons respectively.

The results are set forth in the following table:

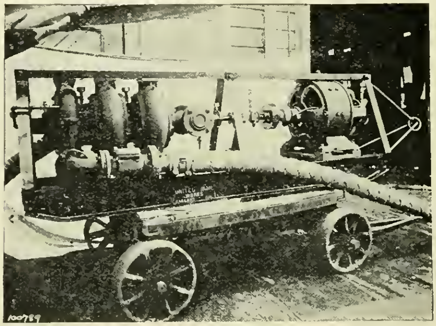
Operating Expenses in Cents Per Mile

	per steam locomotive	per electric locomotive	per steam train (3 locomotives)	per electric train (2 locomotives)	Steam Operation per 100 tons behind drawbar	Electric Operation per 100 tons behind drawbar
Fuel or electricity	65.0	78.0	195.0	156.0	10.8	8.7
Repairs	20.0	5.6	60.0	11.2	3.3	0.6
Wages	18.7	18.9	56.1	37.8	3.1	2.1
Engine house expense	3.5	0	10.5	0	0.6	0
Lubricants	0.9	0.5	2.7	1.0	0.2	0.1
Stores	0.6	0.3	1.8	0.6	0.1	0.1
Totals	108.7	103.3	326.1	206.6	18.1	11.6

Motor Driven Pump for Operation on Inclines

The accompanying illustration shows an interesting application of a motor-driven pump. It is designed for mine drainage and is to be used on inclines up to forty-five degrees from the horizontal.

The pump and motor are held together in a steel frame work with an eye at the end to which a cable or rope is attached for lowering the outfit down the incline. The lower part of the framework acts as a skid.



Motor driven pump for mines.

Special arrangements had to be made for oiling the motor. The lubricating device for the lower bearing is seen between the coupling and the bearing housing; it is fed with oil from the upper end by means of a pipe.

The pump is 4-inch, three-stage, and operates at heads up to 250 feet. The motor has a capacity of 30 h.p. and is of Westinghouse manufacture. Several pumps of this type are in operation and are said to be giving very satisfactory service.

A sub-station which will supply residents of the surrounding district with light and power has recently been erected by the Western Canada Power Company at the junction of the Pitt and Lillooet Rivers, near Port Coquitlam. A pole line to extend from the company's present line on the Lillooet River to the pump house on Pitt Meadows is at present under construction, the completion of which will place the large farming community located on Pitt Meadows, from the Fraser to the upper portion of the Pitt River, within reach of electric power in any required quantity.

THE SOCIETY FOR ELECTRICAL DEVELOPMENT

—Some Observations on the Underlying Principles—

By Mr. J. Robert Crouse

There are always some underlying, basis principles governing all change and progress—whether in the field of research, engineering, manufacturing or merchandising. These principles are of the same essential quality as the axioms in mathematics or refined statements of particular relations, such as $C = E/R$ in our electrical business. Such principles do not depend for their truth or power upon minority or majority assent, and when once fairly stated, are assured of final acceptance since essential progress must be made in harmony with them.

Progress in our electrical business during thirty years (notwithstanding that less than 30 per cent. of the population is electrically served) has been one of the wonders of the world: its contribution to the comfort, happiness and efficiency of our modern life are so great that we wonder how a preceding generation did without it. We may justly feel proud of such a magnificent business which in every department of its development is so worthy of our best thought and effort.

The efforts of those engaged in the fields of research, engineering and manufacturing have shown the most marked results, since, while enjoying the stimulus of the friendly rivalry of other men and organizations, they have been free from the sort of competition which makes the accomplishment of useful results expensive and difficult. It is a matter of common observation that rapid progress has been made in discovery and research, in efficient engineering adaptation of discovery to practical manufacture, and improved products tending to better conditions of generation, construction and distributing systems.

However, in the field of selling and distribution we are challenged by the cold fact that no essential progress—meaning by this a decreasing ratio of sales expense to sales—has been generally accomplished. Not only this, but there is a prevailing opinion among the manufacturers, jobbers, dealers and contractors that the ratio of sales expense to sales tends to increase. The annual reports of some of the largest electrical manufacturers makes specific mention of this tendency as a fact in their operation. Among central stations this is doubtless true, since by common consent they are properly monopolistic for the best results and competitive only with other methods of furnishing service for light, heat, power and other useful purposes.

Our electrical business, technical in its very nature, has doubtless for that reason placed less emphasis in the past on aggressive selling and distributing effort—witness the fact that the first commercial papers in the National Electric Light Association appeared only so recently as 1905, and national advertising by individual companies began about 1907-1908.

It is estimated that the gross sales, ratio of sales expense and sales expense for 1912, in the electrical business, were approximately as indicated in the following table:

Branch of Business	Gross Sales 1912	Per Cent. ratio Sales expense to Sales	Sales Expense 1912
Central Stations	$400,000,000	5%	$20,000,000
Manufacturers & Jobbers .	300,000,000	15%	45,000,000
Dealers & Contractors ...	100,000,000	15%	15,000,000
Total	$800,000,000		80,000,000

This $80,000,000 of sales effort (which is equal to one-fifth of the gross sales of all the Central Stations) is incurred by approximately 5,000 central stations, 500 manufacturers, 200 jobbers, 5,000 dealers and contractors—a total of 10,700 organizations. It is of special importance to note that $60,000,000 of this $80,000,000 sales effort is incurred by the manufacturers, jobbers, dealers and contractors who operate under the complete competitive conditions, at a sales expense ratio of at least 15 per cent.—and tending to increase.

While this table and the above comments are broad generalizations, the reader is asked to check the principle and its application in his own particular case.

These facts in themselves are a challenge to commercial men, which cannot be avoided. They justify the most careful search for causes and investigation of plans for improvement.

Whatever minor causes may be contributory to this failure in more efficient merchandising, the major one, which experience and the facts disclose, is competition among these thousands of companies, resulting in expensive duplication of all kinds of sals efforts and failure to co-operate in a definite organized plan in those kinds of endeavor which supplement legitimate competition.

This competition is to a very great extent to secure the business held by others or of natural growth which we may characterize as the existing market. A very large part of the selling effort is exerted on this existing market and dissipated in commercial friction and lost motion, with resulting decrease in its creative effect.

The age of business (in which someone has said we live to do business, instead of doing business to live, in the base sense) is in the order of social development the successor of the period when war—the extreme of competition—was the principal occupation. Business has inherited from this prototype many habits of enmity, antagonism and waste, which only the persistent cultivation of good fellowship, harmony and economy will gradually supplant. The most successful organizations which I have observed have given the greatest attention to the cultivation of harmony among their men, and the spirit of progressive, constructive effort. This same result must measurably follow similar conscious effort by an entire industry.

The Society for Electrical Development proposes a broad, common organization of our entire industry; central stations, manufacturers, jobbers, dealers and contractors (controlled by a balanced representation from each), through which a part of this $80,000,000 of unorganized and competitive sales effort can be more effectively exerted through organized and co-operative sales effort in promoting and popularizing electrical service. These plans to teach the public to "do it electrically"—many more than can at once be undertaken—have been worked out and endorsed as entirely practical by many prominent men in our business.

The society proposes at the start that a minimum of $200,000 or but one-fourth of one per cent. of this $80,000,000 of competitive sales expense, be co-operatively expended. The basis of subscription is for manufacturers, and central stations, one-fifteenth of one per cent. of gross sales, and one-twentieth of one per cent. for jobbers, dealers and contractors, amounting, for illustration, in the case of the former, to $66.66 per $100,000 of gross business, and in the latter to $50 per $100,000 of gross business—the subscription being on an annual basis. This means in the case of a company having a 15 per cent. sales expense account, but one-three-hundredth of their sales appropriations. There are few organizations which cannot locate competitive expenses of doubtful value equal to the society's subscription. While individual subscriptions are comparatively small and in no sense burdensome, yet general co-operation in the movement will make a fund $500,000 per annum available for progressive and aggressive market cultivation along these new lines.

This society creates the organization and the fund through which some of our dollars can co-operate with the good will of us all in broad effective activity for the expansion of the market, while we continue with the most of our dollars to compete for our fair share.

This plan means real progress in the direction of more efficient distribution of electrical service through joint culti-

vation of our common market—the great pre-occupied, incredulous, money-spending public—a result which our present systems neither accomplish nor promise ever to achieve on the old lines.

The plan presents a new kind of consolidation for sales efficiency through a better balance of competitive and co-operative effort to which the popular thought will not now nor in the future take exception.

The plan means that electrical men—identified with this most wonderful of all business—will demonstrate for themselves and by example for others—the true principles which underlie progress in more efficient sales distribution, through the creative cultivation of the market. The plan lends dignity to the art of selling—synonymous in the best sense with service—and marks a further point in the age now happily passing, when the selling spirit was symbolized in the economist's expression "caveat emptor"—"let the buyer beware."

CURRENT CONSUMPTION OF HEATING DEVICES

—— A Complete List of Capacities ——

Cost of heating by electricity and the question of whether this form of energy is capable of taking the place of coal or gas in ordinary commercial or household operations depends on many conditions peculiar to each locality, but the ultimate situation is continually growing more favorable to the use of electricity. Coal is becoming more scarce and more expensive, while electricity is being constantly reduced in price. Added to this there is the ever increasing efficiency and utility of electrically heated devices. When to these are also added the extra convenience of electricity, its cleanliness, its safety, its instant availability, its attractiveness and the superior quality of the work accomplished it is fair to assume that its use for heating purposes will become much more general in the very near future.

Already the progress that has been made is much greater than the average user of electricity is aware of and the number of appliances, household and otherwise, now being electrically operated is already very great. In this direction there does not seem to be the same chance of development, which must rather he along the line of increasing efficiency in the heating units and in improved design, which will result in a still smaller loss of heating energy.

Some very interesting figures have recently been prepared by Mr. H. O. Swoboda, consulting electrical engineer of the Westinghouse Electric and Manufacturing Company. Mr. Swoboda makes a comparison of the cost of electric heating with the cost of heating with coal or gas as shown in Table 1 herewith.

Table 1.—Comparative Cost of Heat Generated by Coal, Gas and Electricity

Coal—Develops at an average a heat of 12,000 B.t.u. per lb. The efficiency of coal burning heating apparatus averages about 10 per cent. Effective heat obtained from 1 lb. of coal = 1,200 B.t.u.; from 1 short ton of coal = 2,400,000 B.t.u.

Gas—Develops at an average a heat of 660 B.t.u. per cu. ft. The efficiency of gas burning heating apparatus averages about 20 per cent. Effective heat obtained from 1 cu. ft. of gas = 132 B.t.u.; from 1,000 cu. ft. gas = 132,000 B.t.u.

Electricity—Develops a heat of 3,413 B.t.u. per kw.hr. The efficiency of electrically heated apparatus averages about 80 per cent. Effective heat obtained from 1 kw.hr. = 2,730 B.t.u.

Based on these figures, the same amount of useful or effective heat is generated by 1 kw.hr. or 20 cu. ft. of gas or $2\frac{1}{4}$ lb. of coal. It follows that the prices at which electricity would have to be sold, to compete with coal and gas, if there would be no other advantage in using electrically generated heat are:—

Gas—Electricity		Coal—Electricity	
per 1,000 cu. ft.	per kw.hr.	per ton	per kw.hr.
$0.10—	0.2 cents	$1.50—	0.17 cents
0.20—	0.4 cents	2.00—	0.23 cents
0.30—	0.6 cents	2.50—	0.28 cents
0.40—	0.8 cents	3.00—	0.34 cents
0.50—	1.0 cents	3.50—	0.39 cents
0.60—	1.2 cents	4.00—	0.45 cents
0.70—	1.4 cents	4.50—	0.51 cents
0.80—	1.6 cents	5.00—	0.57 cents
0.90—	1.8 cents	5.50—	0.62 cents
1.00—	2.0 cents	6.00—	0.68 cents
1.25—	2.5 cents		
1.50—	3.1 cents		
1.75—	3.6 cents		

As showing the extent of the application of electricity to heating devices, Mr. Swoboda has also compiled the list given below in Table 2. This table shows the amount of maximum energy consumed by each appliance, which permits an approximate calculation of the cost of operating, and it also indicates that electrical heating appliances have been standardized for a great variety of domestic and industrial purposes. In fact, looking at this list, one is led to predict that this development will continue to go on and on and that electrical heating will become quite general in a not too distant future, just as the electric light has superseded the gas light and as the gas range has replaced the coal range, regardless of higher cost of operating.

Table 2.—Capacities of Electrical Heating Devices

The heating capacities, given in this table, are used by the leading American and European manufacturers and represent a fair average of standard practice. The figures indicate the maximum amount of energy required to raise the temperature to the desired point, less energy, of course, being required to maintain this temperature. When two figures are given, both are used, one for slow and one for quick action.

Air Heaters:—	
Convectors, smallest size, three heats	600 Watts
Convectors, largest standard size, three heats	18,000 "
Luminous radiators, smallest size, one bulb, single heat.	250 "
Luminous radiators, largest standard size, four bulbs, two heats	2,000 "
Quartzalite radiators, smallest size, two heats	600 "
Quartzalite radiators, largest standard size, two heats .	1,600 "
Show window convectors, capacity per running yard, single heat	300 "
Street car heaters, smallest unit, three heats	250 "
Street car heaters, largest standard unit, three heats ..	450 "
Air humidifiers (bronchitis kettles)	600 "
Back rounders, for books, three heats	300 "
Beer vat driers, three heats	3,000 "
Boilers, double (cereal cookers), small size 3 pints, three heats	440 "
Boilers, double, largest standard size 6 quarts, three heats.	1,300 "
Boilers, hot water, heaters inside, smallest size 3 gallons, three heats	500 "
Boilers, hot water, heaters inside, largest standard size 100 gallons, three heats	14,000 "
Branding irons, single heat ... ... 150 to	660 "
Broilers, in oven shape, smallest size 16" x 14", two heats.	2,500 "
Broilers, largest standard size, 32"x 30", two heats	10,000 "
Broilers, open plates, smallest size 8" x $7\frac{3}{4}$", single heat.	660 "
Broilers, open plates, largest standard size 39"x19", two heats	6,400 "
Cauterizing instruments, without loss in controller 30 to	75 "
Celluloid heaters, three heats	900 "
Chafing dishes, smallest size 2 pints, three heats	250 "
Chafing dishes, largest standard size 3 pints, three heats.	500 "
Chocolate warmers, for maintaining chocolate in a fluid state for dipping, smallest size 12"x$6\frac{1}{2}$"x5", three heats.	220 "
Chocolate warmers, largest standard size, $14\frac{1}{4}$"x$7\frac{5}{8}$"x6", three heats	264 "
Cigar lighters, continuous service, single heat	25 "
Cigar lighters, intermittent service, single heat ... 75 to	200 "
Circulation water heaters, used in connection with boilers,	

smallest size, two heats ... 1,800 "
Circulation water heaters, largest standard size, two heats. 3,600 "
Coffee percolators, smallest size 1 pint, single heat 250 to 400 "
Coffee percolators, largest standard size 4 pints, three heats ... 350 to 500 "
Coffee percolators, restaurant size, 12 quarts, single heat ... 750 "
Coffee roasters, smallest size 2 to 3 lbs., three heats ... 800 "
Coffee roasters, largest standard size 8 to 10 lbs., three heats. 3,600 "
Coffee urns, smallest size 2 gallons, three heats ... 1,400 "
Coffee urns, largest standard size 5 gallons, three heats.. 2,500 "
Combs, heated, single heat ... 50 "
Corn poppers, 1 quart, single heat ... 300 "
Cooking vessels with covers, smallest size 2 pints, three heats. 600 "
Cooking vessels, largest standard size, 26 gallons, three heats 7,500 "
Corset irons, 8½ lbs., two heats ... 500 "
Cosmetic heaters, single heat ... 25 "
Curling irons, self-containing, single heat ... 20 "
Curling irons, heater in separate tubing, single heat 60 to 400 "
Dentist's tools, such as root canal driers, gutta percha instruments, bleacher points, wax spatulas, hot air syringes without loss in controller ... 6 to 30 "
Disc stoves, smallest diameter 3", single heat ... 100 to 400 "
Disc stoves, largest standard diameter 20", three heats... 2,700 "
Distilling apparatus for ether, three heats ... 300 "
Distilling apparatus for water, smallest size 1 quart per hour, single heat ... 1,000 "
Distilling apparatus, largest standard size 8 quarts per hour, single heat ... 6,000 "
Domestic flat irons, smallest size 3 lbs., single heat 200 to 250 "
Domestic flat irons, largest standard size 9 lbs., single heat ... 400 to 675 "
Drag irons, smallest size 30 lbs., single heat ... 1,400 "
Drag irons, largest standard size 50 lbs., single heat... 1,600 "
Egg boilers, smallest size 1 egg, single heat ... 200 "
Egg boilers, largest standard size 6 eggs, three heats 360 to 600 "
Finishing (polishing) irons, smallest size 4 lbs., two heats 250 to 380 "
Finishing (polishing) irons, largest standard size 5½ lbs., two heats ... 450 "
Fireless cookers ... 150 to 660 "
Flask heaters, 8½" diameter, three heats ... 500 "
Flat plates, rectangular or oval, used as food warmers, griddle plates, laboratory plates, glue plates, smallest size 4x4", three heats ... 60 "
Flat plates, largest standard size 80x40", three heats ... 4,500 "
Foot warmers, smallest size 9"x10", single heat ... 50 "
Foot warmers, largest standard size 10x12", three heats ... 400 "
Frying pans, round, smallest diameter 4", single heat ... 300 "
Frying pans, largest standard diameter, 12", three heats 1,800 to 2,000 "
Frying pans, rectangular, with cover, smallest size 10x6½x5", three heats ... 1,000 "
Frying pans, rectangular, with cover, largest standard size 24x12x5", three heats ... 3,300 "
Furnaces for dentists, with controller ... 500 "
Furnaces for heat treatment of tool steels and other metallurgical work
1,800 deg. F. maximum, smallest size... 450 "
largest standard size... 4,150 "
2,000 deg. F. maximum, smallest size... 650 "
largest standard size... 15,000 "
3,600 deg. F. maximum, smallest size... 10,000 "
largest standard size... 75,000 "
Furnace, Heroult 15-ton steel, with controller ... 1,500 kw.
Furnaces, vacuum type, for laboratory research work
5 cu. in. capacity, 5,600 deg. F. maximum... 15 kw.
125 cu. in. capacity, 3,100 deg. F. maximum... 60 kw.
Glove form heaters, single heat ... 50 Watts.
Glue cookers with circulation water heaters, smallest size 3 gallons, three heats ... 1,800 "
Glue cookers, largest standard size 25 gallons, three heats. 7,200 "
Glue pots with immersed heaters
smallest size ½ pint, three heats ... 150 to 330 "
largest standard size 5 gallons, three heats ... 2,500 "
Gold annealers for dentists with controller ... 400 "
Goose irons for tailors, smallest size 12 lbs. ... 600 to 770 "
Goose irons, largest standard size 25 lbs. ... 825 "
Hat brim irons, single heat ... 50 "
Hat form heaters, three heats ... 500 "
Hatters' irons, 9 to 15 lbs., two heats ... 450 "
Heating pads, smallest size 11x15", three heats ... 50 "
Heating pads, largest standard size 24x60", three heats.. 400 "
Hot air blowers, smallest size, two heats ... 500 "
Hot air blowers, largest standard size, two heats ... 1,400 "
Hot water cups, smallest size ½ pint, single heat ... 150 "
Hot water cups, largest standard size 2 pints, single heat. 500 "
Hot water tea kettles, smallest size 1 pint, single heat 250 to 300 "
Hot water tea kettles, largest standard size 2 quarts, three heats ... 750 "

Hot water pitchers, smallest size 1 quart, single heat 600 "
Hot water pitchers, largest standard size 3 quarts, single heat ... 660 to 10,000 "
Hot water tanks for manufacturing purposes, smallest size 26 gallons, two heats ... 4,500 "
Hot water tanks, largest standard size 52 gallons, two heats 10,000 "
Immersion coils, smallest size 6½" diameter, three heats ... 440 "
Immersion coils, largest standard size 11" diam., three heats. 2,500 "
Immersion heaters, cylindrical type, smallest size 2¾" diameter, three heats ... 300 "
Immersion heaters, cylindrical type, largest standard size 20" diameter, three heats ... 10,000 "
Immersion disc heaters, smallest size 3" diameter, two heats 150 "
Immersion disc heaters, largest standard size 8" diameter, two heats ... 660 "
Immersion tubeheaters, smallest size, single heat ... 170 "
Immersion tube heaters, largest standard size, single heat. 660 "
Inhaling apparatus, smallest size ½ pint, singleheat ... 100 "
Inhaling apparatus, largest standard size 2½ pints, three heats ... 800 "
Instantaneous hot water heaters, smallest size ¼ pint per minute, temperature increase 68 deg. F. ... 600 "
Instantaneous hot water heaters, largest standard size 10 quarts per minute, temperature increase 136 deg. F... 24,000 "
Ironing machine (mangles), smallest size 40" long, three heats ... 2,400 "
Ironing machine, largest standard size 80" long, three heats 6,400 "
Lace iron, single heat ... 70 "
Machine irons for tailors, with controllers, smallest size 12 lbs. ... 770 "
Machine irons for tailors, with controllers, largest standard size 18 lbs. ... 770 "
Melting pots for pitch, smallest size 12" diameter, 2½" deep, three heats ... 1,300 "
Melting pots for pitch, largest standard size 15" diameter, 2½" deep, three heats ... 1,600 "
Melting pots for sealing wax, paraffin, smallest size ¼ pint, single heat ... 80 "
Melting pots for sealing wax, paraffin, largest standard size 5 quarts, three heats ... 550 "
Melting pots for soft metal (lead alloys), smallest size 4 lbs., three heats ... 200 "
Melting pots for soft metal (lead alloys), largest standard size 50 lbs., three heats ... 1,500 "
Milk sterilizers for 8 bottles, three heats ... 700 "
Milk testing sets, single heat ... 600 "
Milk warmers for 8 ounce bottles ... 400 to 500 "
Oil tempering baths, smallest size 9 gallons, with controller 600 deg. F. max. temp. ... 6,000 "
Oil tempering baths, largest standard size 37 gallons, with controller 600 deg. F. max. temp. ... 20,000 "
Ovens for baking, roasting, drying, warming, enameling, smallest size 14x14x18", three heats ... 200 "
Ovens for baking, roasting, drying, warming, enameling, largest standard size 42x30x67", three heats ... 10,000 "
Potato cookers, smallest size 5 quarts, three heats ... 750 "
Potato cookers, largest standard size 10 quarts, three heats. 1,000 "
Potato steamers for hotels, smallest size 20 quarts, six heats 3,000 "
Potato steamers for hotels, largest standard size 50 quarts, six heats ... 4,500 "
Puff irons, smallest size 3x1¼", three heats ... 155 "
Puff irons, largest standard size 6x3½", three heats ... 400 "
Ranges for domestic and restaurant use, 2 to 6 persons.. 4,000 "
Ranges for domestic and restaurant use, 6 to 12 persons.. 5,500 "
Ranges for domestic and restaurant use, 12 to 20 persons.. 7,500 "
Sand box heaters for trolley cars, single heat ... 100 "
Sealing wax heaters, hand tool style, single heat ... 75 "
Shoe irons, portable, single handle, six heats ... 100 "
Shoe irons, portable, double handle, six heats ... 210 "
Shoe relasting irons, portable, single heat ... 50 "
Shoe warmers, smallest size 4"x1¼"x½", single heat ... 20 "
Shoe warmers, largest standard size 8"x3"x1", single heat. 30 "
Sleeve irons, 3½ lbs., two heats ... 300 "
Soldering irons, smallest size 10 ounces, single heat ... 75 "
Soldering irons, largest standard size, 4½ lbs., single heat. 450 "
Steam sterilizers, small size 5 quarts, three heats ... 3,500 "
Steam sterilizers, large size 6 quarts, three heats ... 4,000 "
Sterilizers for surgical and dental instruments, smallest size 8"x3½"x2", three heats ... 350 "
Sterilizers for surgical and dental instruments, largest standard size, 24"x6"x4", three heats ... 1,400 to 1,800 "
Sweating blankets, 60"x18", with controller ... 800 "
Toaster stoves domestic, portable type, single heat 400 to 600 "
Toaster stoves, restaurant type, single heat ... 1,500 to 3,000 "
Towel dryers, three heats ... 600 "
Waffle irons, each section, single heat ... 385 "

Welding machines, smallest sizes ... ... 1,000 "
Welding machines, largest sizes ... ... 150,000 "

"VICTORIA" OFFICE OF THE BELL TELEPHONE COMPANY

—Electrical Equipment of new Montreal exchange—

On July 19th the Bell Telephone Company of Canada opened its seventh branch office in Montreal, the "Victoria," this being the first of the two proposed new offices for the Montreal Exchange in 1913, the other, "Rockland," (to serve the Outremont Exchange) being expected to be completed by the end of the year.

The "Victoria" office is situated in that portion of the "Main" district that is south of the Lachine Canal, including Verdun, and relieves the main office of approximately 1,500 subscribers lines. The building and equipment of the "Victoria" office corresponds very closely to that supplied for the "Gerrard" office recently opened in Toronto, and described in the convention number of the "Electrical News."

The building is 113 feet long by 40 feet wide, two storeys and with a high basement, designed to carry another storey in the future. The construction throughout is of the best fire-resisting type. Special attention has been paid to fire protection, stand pipes with the standard two and one-half inch hose being placed at different points in the building. Sprinklers are placed on the outside of the building over all windows on the upper storey. The front of the building is finished with hard burnt Laprairie plastic brick, No. 1 quality, and red sandstone trimmings. The design is of a simple, dignified character with a large window area, giving the building a maximum of light and air.

The main entrance is on the front, facing Chateauguay Street, the vestibule of which leads into a commodious entrance hall, from which the operators' quarters are entered, occupying the west half of the ground floor fronting on Charlevoix Street. The operators' quarters contain a large locker room (in which are placed the operators' clothes lockers and drying closet), lunch room, kitchen, rest and retiring rooms, and sick room. In the basement beneath the locker room, reached by a private staircase, are the operators' toilet and bath rooms.

The east half of the ground floor is entirely devoted to the housing of the power and terminal apparatus associated with common battery switchboards of the type being installed.

The entire top floor is used as an operating room and contains the subscribers' and incoming trunk switchboards. It is particularly well lighted and well ventilated.

The whole of the central portion of the floor of the operating room, that is between the switchboards, is raised 13½ inches higher than that portion of the floor on which the switchboards stand. This construction permits of the operators sitting on chairs of normal height, and, at the same time, more readily permits of their making any connection to the most distant parts of the switchboard which they are obliged to reach. At the same time access to all parts of the back of the switchboard is exactly the same as in buildings of earlier construction where the entire floor of the operating room is on one level.

A particularly good fire escape is provided outside the building, reached by doors swinging outward from the operating room and from the operators quarters to the ground.

In the basement are situated furnace and coal rooms, men's lavatories, battery room and cable terminal entrance.

The switchboard equipment is of the latest standard common battery relay type, and was supplied by the Northern Electric and Manufacturing Company, Montreal. The lines enter the building underground in lead-covered, paper insulated cables, and are connected to the main frame by silk and cotton-covered insulated cables. The main, intermediate and relay frames, the coil racks for the lines and in-trunk switchboards with their fuse panels, the power plant and two-position inspectors' desk are located in the terminal room at the east end of the ground floor.

The power plant consists of the main battery of 11-G chloride cells and a smaller set of 11-E-11 cells, the latter battery being used to reinforce the main battery for long distance work. Two Western Electric Company's motor generator sets are provided for charging the larger battery, one being held in reserve in case of a breakdown. Each consists of a generator of 18,000 watts capacity at 30 volts, directly connected to a 30 h.p. 550 volt, 3-phase, 25-cycle motor. The generators are of a standard telephone design specially built for charging telephone batteries, having a large number of segments in their commutators and with specially shaped pole pieces, the idea being to eliminate noise from the associated telephone service when the battery is being charged. The smaller battery is charged by a smaller generator which has an output of 600 watts.

Two machines are provided for furnishing alternating current for ringing subscribers' bells and with special interrupters arranged to give automatic intermittent ringing of subscribers' bells on calls originating from the other offices. These interrupters give an interrupted direct current to work the many signalling circuits required for an equipment of this type. The necessary switches, circuit breakers, measuring instruments, etc., are mounted on a black slate switchboard.

From this terminal room the lines are run to the switchboards on the floor above in switchboard cables supported on structural steel runways.

Two separate switchboards are provided, one to care for the subscribers' lines directly connected to this office and the other one, the in-trunk switchboard, to complete connections that originate from the other offices. Both switchboards have a capacity of 10,400 lines and are equipped for 4,000 lines. They are equipped with the latest types of circuits, those of the in-trunk switchboard include the keyless incoming trunk circuits.

All the structural steel telephone apparatus in the terminal room is painted with aluminium paint (not the usual grey iron filler paint) and gives the room a bright and cheerful appearance.

A special feature in connection with the cutover of the switchboards was the manner in which the actual transfer was made. The method used was a new one, and used for the first time by the company. Of late years and up to the present time, the method of opening the subscribers' line relays, in order to keep the signal lamp from burning in the new office, was by inserting a wooden toothpick between the cut-off relay coil and its armature. This was done some twenty-four hours before the cut-over, and necessitated leaving off the covers of the relays, which allowed an accumulation of dust to get into the contacts, beside the troubles that were caused by the armatures being stuck in such a manner as to prevent some lines from calling central. The new method was an arrangement that put the cut-off relay coils under practically the same condition as when being operated in service. After all the preliminary tests were completed, a four-volt battery lead was brought to the end of the subscribers' switchboard in No. 0000 cable. This lead was taken off the two cells at the grounded end of the twenty-four volt battery. At the switchboard, the lead, after going through a 300 amp. switch was attached to a number of fuse strips from which the current was distributed by smaller leads of No. 22 silk and cotton-covered copper wire to the multiple jacks on the board. The fuses on the strips were of five amperes capacity and each protected a lead of 20 lines. The No. 22 wire leads were connected to the multiple jacks by being wrapped around the heads of small metal service plugs which were inserted in the jacks. When all the preparations were made, the current was thrown on by means of the main switch being closed and the relays were operated and kept in that condition until the

word was given to make the transfer.

The charging machine circuit wiring was arranged so as to keep the two cells of battery floating, the machine carrying the load on the board.

At the hour set for the transfer, five o'clock in the afternoon, the temporary wiring connecting the lines being transferred to the old office was cut, the main switch opened, and the service plugs pulled out, the whole operation taking a very small amount of time.

COMPLETE CHAIN OF MARCONI STATIONS

— Government Extending its Wireless System

By the end of the year the Marconi Wireless Telegraph Company of Canada, Limited, will have completed the chain of stations on the Great Lakes. Last year three stations were constructed at Sault Ste. Marie, Midland, and Tobermory, each group comprising two dwelling houses and one operating house. These are known as standard 5½ kw. stations, and each has a range of 350 geographical miles over open water and 260 miles over flat land. The masts are composed of 3 pieces of wood, and are 185 feet high. The operating houses are equipped with Canadian Fairbanks-Morse engines, all the apparatus being designed and manufactured in Canada. At each station the transmitting set is duplicated, so that in case of a breakdown of any part of the machinery, another set can be immediately brought into use—this being important in connection with shipping.

The Port Arthur station, built in 1910, is being remodelled, in order to bring it up to standard requirements. At Sarnia, a station has also been brought into operation, while at Port Burwell, Toronto and Kingston stations will be finished this year. When a suitable site has been obtained, a station will be erected in Montreal, thus completing the chain from Port Arthur, at the head of the lakes, to Quebec, down the St. Lawrence to Newfoundland as far as Cape Race in the south and Belle Isle in the north, covering in all a coast line of over 15,000 miles. With the stations on the Labrador, Nova Scotia and Newfoundland coasts, owned by the the company and the Dominion and Newfoundland Governments, there is a total of 40 stations, all intercommunicating and forming the greatest chain of wireless telegraph stations in the world.

Two large stations are now being erected at Le Pas, Man., and Port Nelson, on Hudson Bay. The Government are constructing a port at Nelson, and a wireless station will be among the first buildings erected. As in the other Marconi stations, the transmission plant at Port Nelson will be duplicated. The stations will be equipped with Canadian Fairbanks-Morse engines and 10 kw. wireless apparatus. This will give a range of 515 miles over water and 450 miles over land, day and night. Both stations will have two masts of tubular steel sections, totalling 250 feet, the masts being 650 feet apart. They weigh 20 tons each with the full equipment. The masts are of special design by the Marconi Company, and are specially suitable for wireless telegraph work in that they absorb much less energy from the transmitted electric waves than the lattice work steel towers used in the earlier days of wireless telegraphy. By means of two stations and the ordinary land wires, communication will be kept up with Port Nelson all the year round, and the building of the port greatly facilitated, as supplies can be ordered as needed. These stations will for the first time break into the absolute isolation that has existed at Hudson Bay settlement in previous winters; in the past the only communications that have reached Port Nelson during the seven months' winter have been those conveyed by dog teams, the drivers of which frequently underwent severe hardship. Thus another of nature's fastnesses is to be conquered by the advance of civilisation, first with its wireless telegraphy, then to be followed quickly by the steel road.

It is stated that the Yukon district may soon have its telegraph service improved, Marconi stations being substituted for the land lines and cables, which have been found very subject to breakdown in that wild and mountainous country.

Personals

Mr. Arthur J. Cantin, formerly sales engineer with the Gorman, Clancey and Grindley Company of Edmonton, Alta., has been appointed superintendent of the electric light and power department of the town of Melville, Sask.

Mr. H. C. Foss, who has been general superintendent of the Savannah (Ga.) Electric Company, has been appointed acting manager of the company. Mr. Foss was formerly superintendent of the Cape Breton Electric Company.

Mr. T. F. Swayze, superintendent of the Niagara Falls, Welland and Lake Erie Railway, Welland, Ont., has resigned to accept a position with the Niagara, St. Catharines & Toronto Railway Company at St. Catharines, Ont.

Mr. A. E. Grant

Mr. A. E. Grant has succeeded his brother, Mr. Lawford Grant, as managing director of the Canadian British Insulated Company, Ltd., Power Building, Montreal. Mr. A. E. Grant has had a wide experience as a marine, mechanical and electrical engineer, and has supervised some extensive contracts. His first position as an electrical engineer was with the Notting Hill (London, Eng.) Electric Light Company, for whom he erected some three-phase machinery, the second of its kind used in the British Isles. Subsequently he joined the engineering staff of the British Insulated and Helsby Cables, Limited, England, which has a large interest in the Canadian British Insulated Company. During his 14 years' connection with the British Company, Mr. A. E. Grant had charge of some important work, including the complete equipment of the Chesterfield tramways, and also the laying of extra high tension mains of the Metropolitan tramways. In 1906 he was appointed manager and chief engineer of the Cardiff office, which takes care of the company's business in South Wales and the south-west district of England. He comes direct from Cardiff to Montreal, and has now taken over the duties of Mr. Lawford Grant, who resigned to accept an important position with the Eugene F. Phillips Electrical Works, Limited, Montreal.

High-Efficiency Tungsten Lamp

As the result of investigations made in the research laboratory of the General Electric Company at Schenectady, N.Y., there has been produced a metallic-filament lamp which operates at the low specific consumption of 0.5 watt per candle—this efficiency being about twice that of the best incandescent lamps heretofore available. The new lamp has a specially shaped tungsten filament and is filled with an inert gas, such as nitrogen, at a pressure of about an atmosphere. The types which it is expected to develop first are adapted to the comparatively high current consumption of 6 amp. and over.

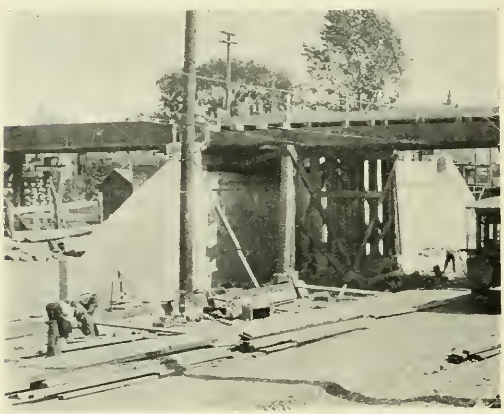
The instant that you make up your mind that everything is coming your way and that you need not hustle any longer, that minute things will stop coming your way.

Electric Railways

North Toronto Grade Separation

For a distance of some three miles across the north of the city of Toronto, the tracks of the Canadian Northern and the Canadian Pacific Railway Companies are being elevated to allow traffic to pass underneath along the roadways running north and south. On a number of these electric lines are operating, and at such points the tracks of the electric line will be depressed some 5 or 6 feet to allow the necessary headway. The reproduction shown represents an advanced stage in the construction work on Avenue Road. The electric tracks have again been laid down by the Toronto Railway Company and the cars are operating as usual. During construction work that part of the Avenue Road line lying north of this point was served by three cars to which it was necessary for passengers to transfer from the main Avenue Road line.

Subways similar to that shown will be constructed on Summerhill Ave., Yonge St., Avenue Road, Davenport Road, Spadina Road, Bathurst Street, Howland Ave., Christie St., Shaw Street, Ossington Avenue and Dovercourt Road, these highways all running practically north and south. The subways, with the exception of Yonge Street are of uniform construction and provide for a 66-foot roadway with 14-foot headway, which clearance will prove ample for all ordinary sorts of traffic. The subways are provided with stout side walls and approaches of concrete and a central dividing row of piers of concrete. The Yonge Street subway will be 86 feet in width and have an overhead clearance of 18 feet. This will be obtained by depressing the street level 9½ feet at this point. The picture shows a view taken from the north-west corner of the work with the eastern wing wall standing out prominently.



Construction work, Avenue Road

Montreal Tramways Mutual Benefit Association

The tenth annual report of the Montreal Tramways Mutual Benefit Association, composed of employees of the Montreal Tramways Company, has just been issued. It is for the year ended April 30, 1913, and gives a summary of the relief work done during the year as compared with the preceding year, as follows:

	1912-13	1911-12
Numbers of members disabled through sickness or injury	1,205	1,173
Number of visits made by physicians to disabled members	695	626
Number of consultations given by physicians to disabled members	7,690	7,587
Number of prescriptions issued	5,769	5,811
Amount paid for sickness and injury	$10,065	$10,274
Amount paid for medicine	$1,840	$1,725
Amount paid for pensions	$408	$354
Amount paid for withdrawals	$508	$296
Amount paid for death and burial insurance	$7,083	$12,533

Mr. J. E. Hutcheson, general manager of the Montreal Tramways Company and president of the association, commented in his report as follows:

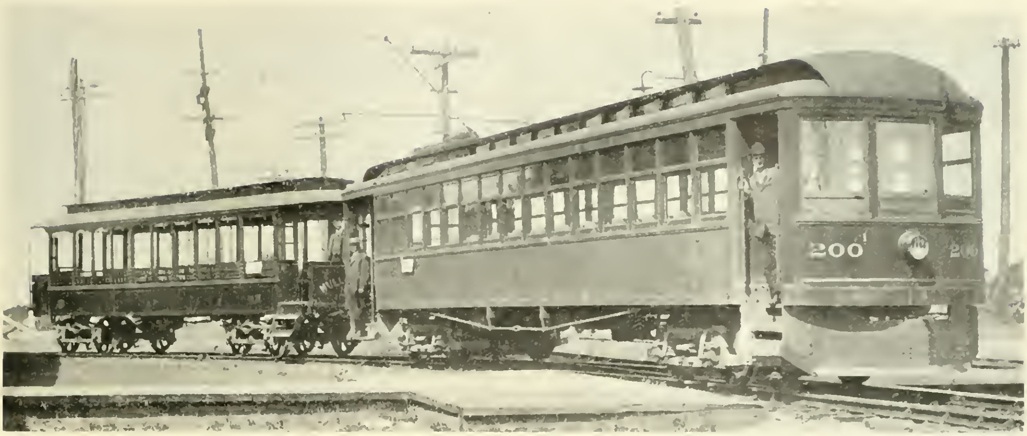
"It will be of interest to members to learn that since the organization of the association the following amounts have been paid out in benefits:

Death and burial claims	$67,643
Sickness and injury benefits	83,765
Medicine	14,648
Medical attendance	19,982
Pensions	1,755
Refunds	1,089
Total	$189,292

"Your committee of management gratefully acknowledges the special Christmas donation of $4,000 received from the Montreal Tramways Company. This makes the total contributions received from the company $18,318, and this amount added to the fees and dues received from the members, viz., $16,651, and the proceeds of the picnic, and the interest on investments, and bank deposits amounting to $15,506, make a total revenue for the year of $50,476. As the expenses were $28,795, the surplus is $21,680."

Two-Car Trains Operating in Hull

The Hull Electric Company are operating with success two-car trains as shown herewith to handle their traffic during the rush hours. The train is here shown passing around a curve of 40 ft. radius. The trailer has a combined entrance and exit at the front of the car and there are no steps at all provided at the rear. Both cars are operated p.a.y.e. with a conductor at the rear of the motor car and a conductor in charge of the trailer. The cars are fitted with Westinghouse S. M. E. air brakes and automatic car and air couplings. In handling the traffic during race week, between Ot-



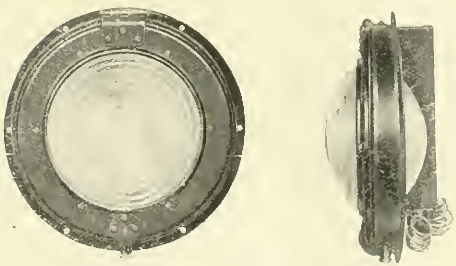
Two car train rounding a 40-ft. curve on the lines of the Hull Electric Ry. Co.

tawa and Connaught Park Jockey Club, this arrangement proved very efficient and economical.

A Pressed Steel Headlight

The Crouse-Hinds Company of Canada have just placed on the market a new headlight, known as type ZP, illustrated herewith. This headlight, which is arranged for flush mounting, is formed from No. 16 gauge sheet steel, and is very

Plain glass, flush mounting, front and side views



With regular semafore lens, front and side mounting

strong and of minimum weight. The housing and reflector are made in separate parts, permitting either to be replaced in case of damage so that it is not necessary to discard the entire headlight when only one part is injured. This arrangement also permits the removal of the reflector for repolishing.

Two styles of parabolic reflectors are made for this headlight, one formed from sheet steel with a smooth white porcelain enameled surface, the other formed of aluminium, highly polished.

The headlight is furnished either with plain glass, plate glass, or semaphore lens in the door, as specified. The door is regularly provided, at the bottom, with a spring catch, although, if specifically ordered, it will be furnished with a locking device that can be opened only with the aid of a socket wrench. This latter arrangement makes theft of lamps difficult. The headlight also is equipped with a porcelain socket, mounted on an adjustable bracket and located at top of headlight, which permits any standard incandescent lamp not exceeding 60 watts to be adjusted to focal point of reflector.

A suitable raceway for the wires is provided on the back of the headlight. A ½-inch conduit hub, with set screw, is located at the lower end of this raceway, making the headlight equally adapted to a conduit or exposed wire installation. The headlight is made with three different radii, namely: 7 ft., 5 ft., and 3 ft. 2½ in., for car dash with 6 ft. to 8 ft., 4 ft. 6 in. to 5 ft. 6 in. and 3 ft. to 3 ft. 6 in. radii, respectively. It will fit a 10¼ in. to a 12¼ in. hole in dash.

Montreal Tramways Good Year

For the year ended June 30th, 1913, the earnings of the Montreal Tramways Company totalled $6,754,227, the operating expenses being $4,032,664, leaving $2,731,562 as net earnings. Allowing for the city percentage, interest, etc., the net income was $638,331. Dividends absorbed $156,382, and after deducting $200,000 transferred to contingent account and $23,670 to capital reserve, and allowing $63,711 for discount on bonds sold, $194,564 is transferred to general surplus. The ratio of expenses to earnings was 59.71; car earnings per passenger 4.09c.; car earnings per passenger total carried 3.06c.; the total passengers carried was 159,892,021, and the transfers 53,505,304. Owing to the fact that the previous statement only covered nine months, no comparison can be made, but the directors state that the increase in gross earnings and the ratio of operating expenses to earnings are satisfactory. The following exclusive franchises have been granted to the company: parish of St. Laurent, 25 years; town of Mount Royal, 25 years; town of Pointe aux Trembles, 40 years; town of Montreal East, 40 years.

Escher Wyss & Company, Montreal, announce that they have severed their connection with Mr. C. J. Printz, who has been up to the present time their agent for the province of Ontario.

Illumination

Correct Illumination
(Specially contributed)

We are again approaching the season of the year when illumination plays one of the most important parts in both our commercial and home life. In the mind of the electrical man there is no other form of illuminant than electric lights, and this conviction is sufficiently backed by facts—cheapness, cleanliness, instant availability—to which must be added safety and artistic effect. These statements are not only not new, but have been repeated so often and are supposed to be so generally recognized that we perhaps forget that there are many people who may not yet have digested them. Proper illumination, with the emphasis on the "proper," is not merely an ideal of a Central Station manager but it reaches the very heart of our social and moral system; therefore it becomes the double duty of every one of us to bring before the notice of all light users the educative and refining value of "electric light" in correct proportions.

Perhaps, too, many of us have been in error in that we have been inclined to advocate "quantity" alone—which meant larger monthly accounts for the central station. This surely is the wrong course to pursue. There are undoubtedly some of our modern streets and especially many of our homes where there is too much glare—we will not say too much "light"—but if the light is not in excess its arrangement and control are so bad that it appears to be too intense. In homes especially, "quantity" ought not to be so much a prime consideration as "effectiveness."

With increasing knowledge of scientific illumination there is no doubt that more satisfactory results are being obtained—but the ideal is some distance ahead yet. The time is probably not far distant when cheapness of electric current will be considered as taking second place to efficiency; glare will give place to light and pleasing shadows, the white hard light to beautiful admixtures of colors.

The real stronghold of electric light, in the home at least, will be not so much in the candles per watt of energy consumed as in the manner in which it lends itself equally well to the combined requirements of illumination and decoration. The influence of a good light on the individual is now pretty generally appreciated but it is open to question if an artistic and beautifully lighted room does not exert a still greater control, and the uplifting value of the two combined with its ultimate influence on our race is a matter worthy of grave consideration by those in whose hands the supply of electric light rests.

The writer would not wish it to be understood that in advocating less glare and better control he is asking the central station to follow a policy which will reduce the revenue. On the contrary, it is evident that many homes, where there is now too much glare, are actually under-installed if a scientific plan of correct and decorative illumination were carried out.

The recent announcement of the invention of a tungsten lamp having an efficiency of one-half watt per candle will if it can be made applicable to the smaller units, effectively remove any competition by gas or other illuminant. This will hasten, in proportion, the day of scientifically correct illumination. The course of the illuminating engineers should therefore be perfectly clear—leading to lighting units in correct sizes and quantities, artistically designed and scientifically installed, that their influence may be stamped on the character of all and sundry who use them.

Electric Lighting of Laundries
By Mr. A.L. Powell, in "Lighting Journal"

One of the chief difficulties encountered in the laundry business is the retaining of experienced help, and the welfare of the employees is therefore an important consideration. The working conditions can be made much more agreeable by a little attention to the subject of good lighting, for it is a well known psychological fact that brightly lighted surroundings have a buoyant effect, and that a dim, dull room is highly depressing. Second, a plentiful supply of light promotes cleanliness; dust and dirt are not so likely to collect in corners and be missed by the sweeper or scrub woman.

Cleanliness is the keynote of the laundry business; and good lighting certainly promotes sanitation. Good lighting also prevents accidents to the employees operating the mamachines. As the result of experience and observation extending over a considerable period of time and in many laundries the conclusions as to good practice for general laundry work and in particular for the machines here illustrated may be stated as follows:

Lighting Systems

Localized general, or group lighting, means the use of medium size units hung moderately high, giving the maximum light at important points, as on the machines with a lower intensity at less important points as in the aisles. It is really general lighting, using common sense and judgment in the location of the lighting units. It is the method by which the majority of laundry processes can be most readily lighted. Analyzing the lighting requirements in a logical order can be more easily grasped by following through the various processes from the receiving to the final inspection and wrapping. In general all references to lamps are based on the dependable, highly efficient mazda incandescent electric lamps and the various reflectors specified should be of enamelled steel of some well known make.

Receiving, Packing, and Marking-in

This is usually done in a fairly large open space. The requirements for light can best be met by general illumination; that is, sufficient light must be provided in all parts of the room to run trucks back and forth with facility, open hampers, and read with ease the ofttimes rather partially obliterated, indistinct markings. For average ceiling heights, the flat dome type enameled steel reflector, hung about 9 ft. above the floor, is applicable on account of its high illuminating efficiency. About three-fourths of a watt per sq. ft.

of floor area is required. This would be given by 100 watt lamps spaced on outlet centers 11.5 ft. apart.

Washers

A localized general system of illumination is applicable here. The exact arrangement of the units will, of course, depend on the layout of the machines. The workman must be able to see the inside of the machine when loading or unloading. There must also be sufficient light to make the necessary gear adjustment, and to avoid accidents, either to the clothes or the workman from the gears and moving parts of the machine. With a single gear machine the light unit should be hung about 1 ft. in toward the center from the gear end, and in line with the front edge of the machine.

A 60-watt lamp with a flat dome reflector hung about 7 or 8 ft. from the floor, will meet the requirements set forth above, and there will also be sufficient general illumination for the soap tanks and aisles.

With the double gear washers, the units should be located above the center of the drum, and 8 to 9 ft. above the floor.

Stationary Tubs

Stationary tubs can be well lighted by a localized, general system of illumination, using efficient reflectors and allowing about half a watt per sq. ft. for the area under consideration.

Extractors

On account of the high speed of these machines and, hence, the greater possibility of accident, a relatively high intensity of illumination is required. The solid curb or under-driven extractors, if located in a row, can be lighted very well by one 60 watt lamp between each two machines. A bowl type reflector giving an intensive distribution of light is particularly suited to this requirement.

The overdriven extractor presents a slightly different problem on account of the liability of shadows from the mechanism. A 40 watt lamp with a 30 degree angle steel reflector, located in front of each machine, hung about 7 ft. high, will direct the light into the body, where required. Between each two machines in the rear a 40 watt lamp with dome reflector should be provided to furnish general illumination for repair work. The latter, of course, need only be used occasionally when this work has to be done.

Tumbler

The lighting requirements are the same as for the washers which have already been described.

Flat Work Ironers

These are made in so many sizes that it is hard to state definitely any one layout. The highest intensity of light is naturally required at the feeding and at the receiving ends. With the single-roll flat work ironer satisfactory light can be secured by locating 1-60 watt lamp with flat dome reflector over the center of the roll, about 8 ft. from the floor. With the multi-roll ironer, and the annihilator, particularly if the latter is equipped with a ventilating hood, at least two units are required; one over the center at each end. A 40 watt lamp with bowl type reflector, giving an extensive light distribution, is the proper unit, hung about 7 ft. from the floor.

Starchers

Collar and cuff, wrist-band and bosom. These are all relatively low machines with no overhanging parts; they are usually located in groups, and can be lighted by general illumination, simply taking care to locate the units so as to avoid heavy shadows on the work from the operators. With efficient flat dome reflectors, about half a watt per square foot is required.

Conveyor Dryers

The requirements here, a low illumination value, just to see to load, may be met with a 60 watt lamp, hung about 7 ft. from the floor, located in the middle of the rectangle formed by the racks and housing. This will light both the loading and unloading portion. A flat dome reflector should be used.

Dampeners

Collar, cuff and shirt- have approximately the same lighting requirements as the starchers—efficient flat dome reflectors with an allowance of half a watt per sq. ft.

Ironers

Collar and cuff, neck, wrist band, sleeve, body and bosom These machines are all relatively low, and hence can be lighted by general illumination, taking the precautions as stated above. A higher intensity of light is required than for the starchers and dampeners, for ironing is a final process; hence, more care must be taken. Allow from three-fourths to one watt per sq. ft.

Cuff, Yoke and Neck-Band Press, Seam Dampeners, Collar Shapers, Tab Tippers, Etc.

The above machines are relatively small and the processes are largely automatic on the part of the operators; hence general illumination will provide sufficient light for these operations.

Ironing Boards

Although general illumination will really suffice here, the work is usually fine and frequently the operator may stand in her own light, if a localized light is not provided. The best practice seems to indicate 1-25 watt lamp with bowl shaped steel reflector, hung near the left end of the board, and about 3 ft. above it. As ironing is done from right to left, with the lamp in this location, the iron will never cast a shadow on the goods about to be pressed.

Inspection and Wrapping

This is frequently done on benches with racks at the rear of the bench. Units of a relatively high intensity must be provided on these benches to enable employees to detect any blemish or speck in the finished product. Light must also be provided for the compartments of the racks. A double row of tables can well be lighted by a row of units in the aisle, say 60 watt lamps with bowl-shaped steel reflectors, giving an extensive distribution, spaced 8 ft. apart and hung about 8 ft. high. The single row can be lighted with 40 watt lamps equipped with bowl-type steel reflectors, intensive distribution, hung about 4 ft. above the bench, located in a row about 6 in. from the front of the bench, and spaced on about 8 ft. centers.

Rectifier-Tube Operating Records at Detroit

High average and individual life records in the operation of rectifier tubes have been attained by the public lighting plant at Detroit, Mich., where advantage is taken of the low-temperature cooling water flowing through the Detroit River from Lake Huron. One 4 amp. seventy-five-lamp tube has, for example, been in continuous service 11,629 hours. Another tube, started August 15, 1910, and ran until May 6, when it was removed after 10,562 hours use.

For the ninety-seven tubes now in use a total of 324,416 tube-hours has been recorded, an average of 3,344 hours per tube. Forty-five tubes now resting showed an average life of 2,692 hours, while 101 which have been discarded ran 2,696 hours each. These 243 tubes have altogether, therefore, run 712,831 hours, or an average of 2,93. hours per tube

A mean operating temperature of 80 deg. Fahr is maintained at the tubes, the cooling water taken from the Detroit River in front of the station ranging from 53 deg. in winter to 70 deg. in summer. Nearly 3,000 General Electric 4 amp. magnetite lamps are now in service for lighting Detroit's streets — Elec. World.

The Dealer and Contractor

Electric Trucks in Contracting Work

Thousands of tons of coal and general building supplies have been delivered during the past three years in Detroit by three 5-ton electric trucks installed by the Electric Truck Company of Detroit and made by the General Vehicle Company, Inc. These three huge trucks, with traveling cranes, have attracted much attention on Detroit streets, where they have been seen daily and practically without interruption year after year, during warm and cold weather and on rainy days and on days when the snow was so deep that it prevented street cars from maintaining their schedule.

It is stated by the J. A. Mercier Company that these trucks have hauled on an average of slightly above 40 tons of coal and have traveled an average of 48 miles daily for years. It is the custom of the truck drivers to boost the batteries at noon. Under these conditions 48 miles are covered each day, but where the batteries are changed at noon the trucks will carry as high as 50 tons per day and will travel over 60 miles.

This is stated to be two and one-half times the amount of work that was accomplished by horses in the old days, and the Mercier company cannot see how it could have attended to the added work which has come to it within the last three years without the motor trucks. The work performed by these trucks during most of the day is the hauling of coal to the plants of the Central Heating Company, and a full 5-ton load is taken each time. The body is lifted clear of the truck with its load, dumped, and replaced, thus saving much time.

Another important installation is that of the A. A. Albrecht Company, whose offices in Detroit are in the Penobscot Building. This company employs constantly one truck of 2½ tons capacity and another of 3½ tons. The company has had the 2½-ton truck in use constantly for 3½ years, and the 3½-ton truck in use for one year. These trucks cover 35 to 40 miles a day, and are employed in carrying building material for use in the various business ventures of the company, which is one of the largest builders in Detroit.

Mr. Albrecht says "I cannot say too much for the work of my trucks. They are running all of the time. All we have to do is to keep them charged and they are constantly on the run. I have yet to see the time when there was an opportunity to 'knock' this installation, which has been a godsend to us. I presume that were we to install horse-drawn wagons for this labor our expense would be increased to at least three times what it is at present. When the motor truck came in, we recognized it as an improvement over all former methods of hauling, and we adopted it upon the same plan as we adopt any great improvement.

"The cost of taking care of our increased business during the past several years with horses would have been practically prohibitive, and would have cost us a fortune. The trucks entered our business when they were most needed, and horse-drawn wagons rapidly became obsolete with us. The total increased demand upon the delivery facilities in our business and its numerous branches was entirely taken care of by our power wagon equipment. The trucks have been in the repair shop but very little, and in fact I know of no serious complaint. We have often-times carried great over-loads without any trouble whatsoever. I believe that our general satisfaction has been due to the electric trucks, although I am informed to-day that since we secured these trucks, gasoline-driven vehicles have improved greatly. We use former teamsters, who have been educated in the operation of the trucks.

"Our men look very carefully after their trucks at all times and are very proud of their work. Upon returning from their day's work, the truck is placed in its regular location, the battery is taken away and charged, and the men arrive in the morning regularly in plenty of time to replace the batteries and to start their day's work. Each of the trucks receives a yearly overhauling."

In the yearly overhauling of the trucks, every part receives careful examination, and all parts needing renewal are replaced. It is noteworthy that there have been few replacements during the time the Albrecht company has owned these trucks.

As regards speed, with full loads of tile, lumber and cement, the trucks had at times covered easily six miles per hour. With five tons, the 3½-ton truck has covered six miles easily, although the regulation speed of the truck is but seven miles. The electric vehicle has proven a splendid puller.

Mr. Albrecht believes that the economy of the electric truck over the gasoline truck for short hauls is in the neighborhood of fifty per cent. at least, and in his enthusiasm he stated that the beauty of the trucks he had, laid in the ease of operation and in the fact that the trucks were working all of the time.

New Broadway Sign

The well-known Corticelli Kitten sign, formerly on the roof of the Albany Hotel, New York, has been removed from there and installed over the Heidelberg Building, on a much enlarged and more elaborate scale. The new display was installed by the A. and W. Electric Sign Company, of Cleveland, measures 100 feet long by 35 feet high, and uses 4,000 8-candle power mazda lamps.

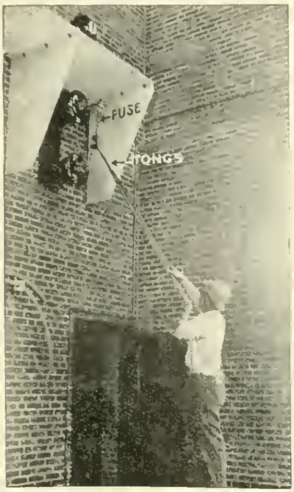
The display is installed in two sections—one occupying 52 feet on Broadway, and the other 48 feet on 42nd street, opposite the Times Building. A Reynolds flasher operates the sign on 42nd street, giving the kitten a very realistic moving effect, showing the spool of silk revolving as the kitten plays, the paws moving in quick action pulling the thread, which tangles around the paws and body of the kitten. A very life-like moving effect is given to the tail of the kitten as it plays with the thread. The wording, Corticelli Silk, Does Not Knot, flashes—each line separately.

The Broadway sign shows first the New Home Sewing Machine in outline, standing still. The machine begins to run rapidly showing the wheels revolving, the belt running with spool of silk on the machine revolving and feeding

rapidly to the moving needle bar; then the wording, Sew With Corticelli Silk, flashes on, followed immediately by the kitten at the left playing with the spool of silk. The kitten plays with the silk a few seconds, then raises to its haunches, and is attracted by the silk running through the needle of the moving sewing machine, the kitten drops down, and then leaps to the table of the machine and plays with the silk thread running down the needle bar and becomes entangled in it to such an extent that the machine stops, and then the entire display becomes dark.

66,000-Volt Sub-station Fuses

Among the recent developments in high tension circuit interrupting devices, the chemical fuse has taken high rank and its successful operation under severe short circuit conditions is rather remarkable. During the past three years, the lower voltage fuses have been extensively used and many tests have been conducted on all pressures up to 33,000 volts. A recent development for use on 66,000 volt systems is shown



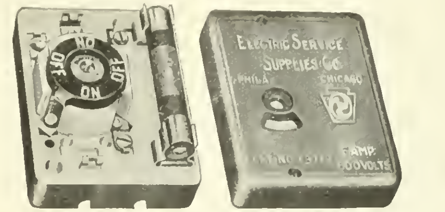
A new type fuse

in the accompanying illustration and the successful operation of this equipment is of interest to central station managers. This particular installation is used to protect a 3-phase sub-station taking current at 66,000 volts and transforming to lower commercial potentials. The illustration shows one phase of a three-phase service and also the method of handling the glass tube fuses by means of insulated tongs. Five ampere 66,000-volt fuses have been blown under heavy short circuit conditions on a feeder having behind it a generating capacity of 27,000 kv.a. The short circuit occurred close to the generators and the fuse successfully cleared the line in a fraction of a second. This new protective device is manufactured by the Delta-Star Electric Company, Chicago, who state that they are now conducting a series of investigations all on commercial potentials up to 110,000 volts. The cost of this circuit interrupting device is much less than that of oil circuit breakers or switches which is an important feature in selling current from high tension transmission lines.

The Rudel-Belnap Machinery Company, Express Building, Montreal, have recently been appointed representatives for the province of Quebec of the Packard Electric Company, Limited.

Improved Car Lighting Switch

A car lighting switch of improved design has been placed on the market by the Electric Service Supplies Company, to provide for the increased capacity required by modern car lighting installations. The adoption of a switch mechanism rated at 5 amperes gives them sufficient capacity to control several series of lamps. This mechanism is of the barrier type which will successfully handle 600 volts at considerably



Improved design car-lighting switch

above the rated ampere capacity. This is accomplished by operating the switch blades in a narrow slot between two porcelain barriers, allowing a very small air space which is virtually a vacuum, and which the arc cannot follow. Spring clips provide for a five ampere enclosed fume, which may be quickly replaced. These switches have bases 3⅛ x 4 inches, and are 1⅞ inch deep, with a cover in place, excluding the handles. The bases, cover and handles are made of chocolate-colored porcelain presenting an attractive appearance.

A New Porcelain Strain Insulator

A new porcelain strain insulator of remarkably high strength, both mechanically and electrically, has just been placed on the market by the Westinghouse Electric & Manufacturing Company, at East Pittsburg, Pa. The manufacturer recommends these insulators for use on 1500 volt direct cur-

Various sizes of new insulator

rent railway work and on 2200 volt transmission lines, a class of service for which porcelain insulators have been seldom used in the past. It is claimed that the insulators will stand more strain than any cable used in line construction that will pass through the hole. They are of the interlinking type which makes it impossible for cables to separate even if the insulator should become shattered. The glaze is of a dark brown color which does not attract the attention of those mischievously inclined. Sharp corners which would be apt to chip have been avoided and the shape of the grooves is such that the wires lie naturally in them. A large creepage distance is provided by the shape of the insulator which makes it suitable for high voltages. The smallest size of these insulators has a flashover voltage on rain test of over 13,000 volts, and the larger size, over 20,000 volts. The tensile strength of the larger size insulator is over 23,000 pounds, and its dimensions are only 5 x 4½ x 4½ inches.

The National Tube Company, Pittsburgh, Pa., announce that, commencing August 1, they are entering the electrical conduit field and have contracted with the National Metal Moulding Company and the Safety-Armorite Conduit Company, both of Pittsburgh, Pa., to manufacture and sell this product for them as their agents

A New Single-Phase Motor

The Westinghouse Electric & Mfg. Company have placed on the market a new line of single-phase motors, made in capacities of 2 to 10 horse power and suitable for the majority of constant speed applications within their capacities. This motor is of the repulsion-starting type and when up to speed, runs as an induction motor. For most applications it can be connected directly to the line, but where very low starting current is desired, a starting rheostat can be used. The frame is so designed that it combines great strength and radiating capacity with minimum weight and over-all dimensions. The laminations are rivetted together under pressure and pressed steel end plates are rivetted to the unit thus formed. The foot, or base, is of pressed steel plate securely rivetted to the end plates; this use of pressed steel marks an important step forward in the design of large single-phase motors. The bearings are large and dust-proof. The rotor coils are form-wound and arranged to permit excellent ventilation. The commutator is of the radial type with undercut mica segments. The shaft can be pressed out of the rotor without disturbing the windings or the commutator. Each motor can be arranged for operation on either 110 or 220 volt circuits.

Electric Drills on Panama Canal

We illustrate herewith a typical scene of the construction work on the Panama Canal, showing 112 large size "Hard Service" electrically operated drills supplied by the Van Dorn Electric Tool Company. The advantages of electricity over compressed air for all similar types of work are now pretty well recognized. Efficiency of electric tools remains the same through their natural life which is not the case with pneumatic equipment, which tends to decrease with use. Also, as a general proposition, electric equipment will accomplish 50 per cent. more work and at one-third of the cost. Temperature effects are also inappreciable and electric tools are free from vibration, and easy to handle. There is also practically no limit to the distance electric tools can be taken from the source of power. Further, work can be continued, when necessary, after hours or at such time as the compressor would be shut down, as power can be taken from the lighting circuit.

Montreal Jovian Club

The Jovian Club has now been opened at Cooper's Restaurant, Montreal. The executive committee is composed as follows:—Messrs. W. B. Shaw, president of the Montreal Electric Company, representing the contractors; W. J. Doherty, sales manager Northern Electric and Manufacturing Company, representing the supply houses; R. M. Hannaford, engineers' department Montreal Tramways Company, representing the traction interests; C. E. Duncan, representing the manufacturing interests; C. M. Tate, chief inspector electrical department Canadian Fire Underwriters' Association, representing the inspecting interests; W. H. Winter, plant superintendent, Bell Telephone Company, for the telephone interests; and P. T. Davies, Montreal Light, Heat & Power Company, representing the power interests. Mr. James Bennett, president, and Mr. D. H. Ross, vice-president of the club, are also on the committee.

Silent Waverley Electric Boxed for Shipment to Japan

Boxing a $3,500 automobile for shipment to a distant part of the world is an important piece of work, since electric automobiles are not primarily designed to be lifted by derrick and dropped roughly down the hatchway of an ocean going ship. Within a week, however, two such shipments have been made from the Waverley factory at Indianapolis, one going to Lima, Peru, via New York, S.S. Allianca to Colon, across the isthmus to Panama and then down the west coast of South America by steamer again to Callao. The second shipment was of a Model 98 Silent Waverley Limousine-Five shipped via Chicago and Seattle in care of the Japanese line at that port to Yokohama, Japan, for delivery to the purchaser at Tokio, Mr. Kuhara, President of the Kuhara Mining Company.

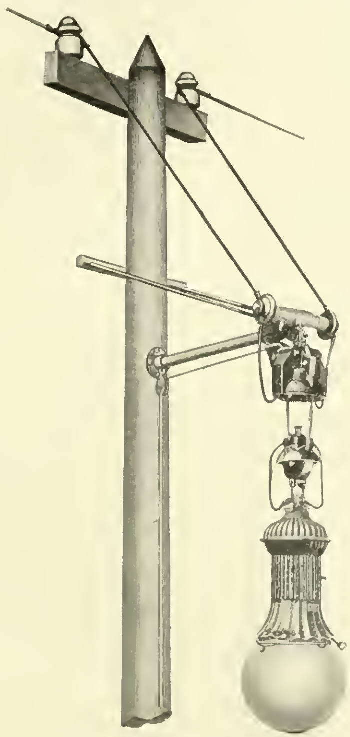
International Engineering Congress, 1915

The Committee of Management of the International Engineering Congress, 1915, takes great pleasure in announcing that Col. Geo. W. Goethals, Chairman of the Isthmian Canal Commission and Chief Engineer of the Panama Canal, has consented to accept the Honorary Presidency of the Congress and will preside in person over the general sessions to be held in San Francisco September 20-25, 1915.

Van Dorn electric drills at work on the Panama Canal.

A High Voltage Cut-out Hanger

The Thompson Electric Company of Cleveland, have recently brought out a simple, compact hanger to take the place of the suspension equipment now used on series arc lamps. By its use the lighting of any lamp automatically cuts it out of the circuit without disturbing in any way other lamps in the same series. Two distinct advantages claimed in the use of this hanger are, that all wires are carried in straight lines from the pole to the hanger, and that the trimmer can perform his work with perfect safety because it is impossible for him to touch a lamp until it has been



High voltage cut-out hanger.

disconnected and lowered entirely away from the circuit. The figure shows the lamp just disconnected and ready for lowering to the ground. The latches and all current carrying parts are enclosed in heavy porcelains specially designed to afford good insulation and at the same time protection from the weather. It will be seen that the lamp is so supported that the trimmer is required to sustain only half its weight.

Contracts Let at Wasdell's Falls

In connection with the hydro-electric development which the Hydro-electric Power Commission of Ontario are undertaking at Wasdell's Falls on the Severn River and from which point they will supply power to the villages and towns in the neighborhood, the following contracts have been awarded:—dam and power house, Galbraith & Cate; turbines, Boving and Company of Canada; generators, Swedish General Electric Company; transformers and switching equipment, Canadian Westinghouse Company; stop-log winch and head-gate mechanism, Wm. Kennedy & Sons.

Trade Publications

Couplings and Pulleys—Bulletin 1320, issued by the Canadian Allis Chalmers Limited, Toronto, descriptive of friction clutches, couplings and pulleys.

Fire Prevention—The Fire Prevention Company of Canada, Limited, Board of Trade, Montreal, have issued an illustrated pamphlet descriptive of the Reichel Automatic Fire Alarm signal system.

Correct Illumination—A leaflet issued by the H. W. Johns-Manville Company, describing Frink and J-M Linolite systems of illumination, with illustrations. The lighting of switchboards in central stations and telephone work is feature.

Small Motors—Monthly Publication No. 16, issued by the Industrial & Power Department of the Westinghouse Electric & Manufacturing Company. This number is devoted exclusively to the application of small motors to washing machines.

Line Material—The Line Material Company, South Milwaukee, Wis., is sending out a series of four folders, calling attention to the merits of "The Kyle Line" malleable iron bracket, pole line hardware and construction material, arc lamp insulators and hangers, and the "Hendee" flexible insulator bracket.

Motor Converters—Pamphlet No. 20-C, being distributed by the Bruce Peebles & Company, Limited, descriptive of Peebles motor converters. The principle of the motor converter is fully dealt with and under the heading "Uses of Motor Converters" it is shown that they are equally suitable for traction, lighting, traction and lighting combined, and for three-wire balancing.

Westinghouse—Folder 4223 describing Westinghouse electrical equipment for automobiles and garages, including a 6 volt, single-wire, starting, lighting and ignition system developed by that company. Pamphlet 4254, descriptive of Westinghouse 3-inch meters; these are adapted for automobile battery equipment. A descriptive leaflet 2321 covering type C S squirrel cage induction motors for constant speed service.

Illustrated Review—A record of industrial and other developments in the twin cities of Port Arthur and Fort William, published by the local branch of the Switchmen's Union of North America. The review is very complete, dealing fully, among many other things, with the electrical utilities in these two cities. It is splendidly printed and illustrated and is entirely a credit to the organization responsible for its production.

Calgary Facts.—The city of Calgary has issued a number of pamphlets dealing with the industrial and commercial phases of that district, and emphasizing the opportunities throughout the province of Alberta. Under the heading of "Cheap Power" it is pointed out that within a radius of a very few miles there is anthracite, bituminous and lignite coal which can be cheaply mined. The southern portion of Alberta is underlaid with gas wells with a larger daily producing capacity than any other locality in America, and the swift running mountain rivers passing through and adjacent to Calgary furnish hydro-electric power at lowest prices. Calgary is municipally owned, controlled and operated. All public utilities, such as street railway, electric light and power, waterworks and paving plants are operated on a satisfactory paying basis.

"Nulites" in Train Lighting

The Canadian Tungsten Lamp Company announce that they are now manufacturing 10 and 15 watt, 25 to 34 volt spherical train-lighting drawn wire tungsten lamps of the same high quality as the rest of their Nulite productions.

Current News and Notes

Aurora, Ont.

By a vote of 287 to 18 the property owners of the town of Aurora favored the expenditure of $16,000 for the necessary electrical equipment to distribute power recently contracted for with the Toronto and York Radial Railway Company. A second by-law authorizing the expenditure of $5,000 for the purchase of electric pumps was carried by the same majority. Work will be proceeded with at once. The number of street lighting units will be increased from the present 60 to about 300.

Brandon, Man.

Fire completely destroyed the local telephone office on July 24th. The loss is placed at $100,000.

Brantford, Ont.

The city of Brantford's claim against the street railway company for tax arrears now amounts to some $28,000. The feeling is in favor of the city taking over the system and operating it as a municipal enterprise.

Calgary, Alta.

Superintendent McCauley claims a record in the unloading, assembling and placing in operation, between 8 o'clock a.m. and 6 p.m. the same day, of two new cars recently received from the Ottawa Car Company. The latest arrivals bring the total of Calgary's rolling stock to 69, comprising 62 motor cars, 6 trailers, and 1 observation car.

The June net earnings of the Calgary street railway system were $12,136, as against $13,490 for the same period a year ago, though the gross was $65,967, as against $54,908 for June, 1912. This is an indication of the generally experienced rapidly increasing operating costs due in this case to a larger wage account added to increased power, interest and sinking fund charges.

Fort William, Ont.

The Board of Trade of the city of Fort William have requested their Utilities Commission to give a cheaper rate for current use for cooking purposes. In view of last year's considerable profit in this department it is suggested that the city could afford to offer a rate of 1½ c. per kw. h.

Tenders were called up to August 12, for extensions to the Fort William car barns.

Fort Frances

Plans submitted by the Ontario and Minnesota Power Company for the construction of a dyke along the Fort Frances river front and showing a railway along the top of the dyke, have been rejected by the town council.

Fergus, Ont.

The Hydro-electric Power Commission of Ontario has made an estimate on the supply of power to Fergus and Elora.

Georgetown, Ont.

The Hydro line from Guelph out to Rockwood and Georgetown has been completed and power was turned on in Georgetown during the first week in August.

Innisfail, Alta.

A by-law will be submitted on August 26 authorizing expenditure of $6,000 to complete the erection of the municipal electric light plant.

Kamloops, B.C.

The recommendations of the consulting engineers on the hydro-electric plant being installed for Kamloops, Messrs. DuCane, Dutcher & Company, recommend that the contract for the forty-three miles of aluminium transmission line and equipment be let to Messrs. Pierson, Rouding & Company. Other recommendations are as follows: telephone equipment, Northern Electric Company; turbines, Platt Iron Works; generators, Canadian Westinghouse; switchboard, transformers, and hardware for the transmission line, Canadian General Electric Company. The total cost is calculated in the neighborhood of $245,000. Mr. C. L. Wain is power-house superintendent.

Le Pas, Man.

Tenders are called up to August 20 for the construction of the power house to accommodate the new generating plant.

London, Ont.

The population census is at present being taken and it is anticipated that the London Street Railway Company may be required to extend their system another couple of miles as their agreement calls for extensions on a population basis.

Montreal, Que.

Tenders have been asked for the construction of the second portion of Montreal's underground conduits—from Craig Street to Pine Avenue, and between Atwater Avenue and Guy Street, on St. Catherine Street.

Owing to a small fire behind one of the switchboards at the Montreal central office of the Bell Telephone, the service in the main district was interrupted for three or four days. For a short time thousands of phones were put out of commission, but the company rushed men in from many points, and work was carried on day and night until the service was re-established. The fire was easily put out, but not before it had rendered useless a mass of wires.

It was stated at the annual meeting of the Canadian Light & Power Company, held in Montreal, that the connected load on the company's system amounts to 26,538 horse-power, while the number of light customers total 5,144 and power customers 581.

Following the passage of a recent by-law a license fee at the rate of 10 cents per square foot on all electric signs will be collected annually in the future in Montreal.

The North River Power Company are supplying current for lighting Rigaud, Point Fortune and St. Eugene, P.Q., the power being supplied by the National Hydro-electric Company from their power house at Carillon Falls. Another company is being formed to supply light to Vaudreuil, Como, Hudson Heights, Dorion and Ile Cadieux.

The board of directors of the Montreal Tramways Company has been increased from seven to nine, by the addition of Mr. P. J. McIntosh and Mr. W. G. Ross. The former gentleman is confidential assistant to Mr. W. Rockefeller, and is associated with a group of New York financial institutions; while Mr. Ross was at one time managing director of the tramways company. The board is now composed as follows: E. A. Robert, president; J. W. McConnell, vice-president; F. Howard Wilson, Geo. G. Foster, K.C.; W. C. Finley, Hon. J. M. Wilson, J. M. McIntyre, G. W. Ross, and P. J. McIntosh.

Nelson, B.C.

A by-law was recently defeated in which the council asked authority to guarantee bonds of the street railway system to the extent of $40,000 for the purpose of taking care of the company's present indebtedness and providing for additional necessary extensions and rolling stock.

Ottawa, Ont.

It is stated that the report which the conservation commission has been preparing on the Long Sault power development proposition will be ready in a short time for submission to the government. It is to be expected that the report will be unfavorable to allowing any United States company to develop and export power from the Canadian side.

Orillia, Ont.

An agreement has been reached between the Water, Light & Power Commission of the town of Orillia and the Department of Railways and Canals, Ottawa, whereby the town's power plant which is now situated at Ragged Rapids on the Severn River will be removed from that locality to a point known as Swift Rapids, some 1½ miles further down stream. This change is made necessary on the part of the government to facilitate work on their Trent Valley Canal scheme. It is also agreeable to the town of Orillia in that they will be able to install equipment of more recent date than that at present operating at Ragged Rapids. It is understood that the government will bear the entire cost of the new power house and will contribute a further sum of $25,000 in cash amounting to a total of at least $110,000. The town will have to supply a quantity of new machinery, the capacity at the new site being rated at about 3,500 h.p. By the move in location the head will be increased from 34 to 47 feet.

Prescott, Ont.

The transformer station here is being constructed by H. G. Wynes. The Canadian General Electric Company are supplying the equipment.

Peterboro, Ont.

The present feeling of the power committee of the Peterboro city council is that the property of the Peterboro Light & Power Company be expropriated and the price arranged later by arbitration.

Rockwood, Ont.

During the first week in August electric light supplied from Niagara by the Hydro-electric Power Commission of Ontario was turned on here for the first time.

Regina, Sask.

The operation returns for the municipal street railway system for the city of Regina for the week ending July 19 showed a total revenue of $3,683.10. The number of passengers carried, exclusive of transfers, was 93,196. For the week ending July 26 the corresponding figures were $4,011.50 and 94,970.

In connection with the Regina Street Railway System, the City Commissioners have given an order to Bruce, Peebles & Company, Limited., Edinburgh, for a motor converter set. The contract was placed through Roper, Clarke & Company, Montreal. The converter is 1,200 kw. at 550-600 volt d.c., taking current at the a.c. end at 2,200 volt, 60-cycle, 3-phase. It will run at 450 r.p.m., and is a 3 bearing machine, complete with switchboards.

St. John, N.B.

Mr. W. H. Balcke of the Stone & Webster Engineering Corporation is reported to have been looking over the situation at Meductic Falls preparatory to the commencement of development operations this fall.

St. Catharines, Ont.

On August 1st the rate payers voted favorably on the enabling by-law as a result of which an estimate will be prepared by the Hydro-electric Power Commission at the cost per h.p. of supply at this point.

Tillsonburg, Ont.

The Tillsonburg Electric Car Company has been finally organized with the following officers: C. G. Davis, president; V. A. Sinclair, vice-president; J. T. Bailie, manager; Jas Chandler, superintendent; Jno. McIntyre, L. Merrill, G. W. Tillson, H. Schafer and William Russ, secretary-treasurer. The building is reported to be nearly complete and that operations will be commenced in the near future. It is said that a considerable order has already been received.

Toronto, Ont.

The Canadian Moloney Electric Company have opened their Toronto office in the new C. P. R. Building.

By the end of the present year it is calculated that half the collegiate institutes and public schools will have been wired for the use of electric light and small quantities of power.

Gross earnings for the first seven months of the Gerrard street municipal electric railway line are in excess of the operating expenses by some $1,500. This however, does not make any allowance for depreciation or interest charges on the original investment which would be between $11,000 and $12,000 for the same period.

The council of the township of York have voted in favor of giving a 20-year franchise to the Forest Hill Electric Railway Company, but it is understood the matter has yet to be submitted to the township rate payers before the franchise can take legal effect.

Appeal against the decision of the High Court being made by the Toronto and York Radial Railway Company in the matter of the diversion of its tracks from Yonge Street at Farnham Avenue will come before the Privy Council in London during October next.

It is reported that the Hot Point Electric Heating Company, of California, will build a large branch manufacturing plant in Toronto.

The gross receipts of the Toronto Railway Company for the month of July were $500,021, of which the city's share is 20 per cent. or $100,004. It looks as if the city would receive approximately $1,000,000 in revenue from the company this year.

Two or three electric trucks will be required in the near future in the baggage transportation department of the Union Station. Mr. Ambrose is chief of this department.

Works Commissioner Harris has been asked to report on further extensions to the municipal street car system, including, Wychwood, Leaside, North Toronto and other outlying points.

Winthrop, Ont.

Plans have been drawn for an extension to the McKillop township telephone system to cost in the neighborhood of $2,400.

Watford, Ont.

The town council contemplate the installation of a lighting system. Power to be supplied by the Hydro-electric Power Commission of Ontario.

Weston, Ont.

Extensions to the distributing system throughout the township of Etobicoke are being planned by the Weston Water, Power and Light Commission.

Winnipeg, Man.

The contract has been awarded for 90 double arm and 40 single arm ornamental combination street lighting and railway standards. The poles will be supplied by Dawson & Company, who are agents for the Electric Railway Equipment Company.

The Commercial Power, Light and Coal Company, Limited, has been incorporated with a capital of $250,000, with head office at Winnipeg.

The Winnipeg Electric Railway Company are at present rushing construction work on the new line to Fort Garry. It is reported that the company have already over three miles of rails down and the trolley wire strung and that the grading work has been done on another three miles.

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

Engine and Generator For Sale

Owing to the Town of Stayner having secured a supply of power from the Hydro-Electric Power Commission of Ontario this equipment will not be needed after Sept. 1st. 1913.

1 100 H.P. 2 cylinder vertical Fairbanks-Morse Gas Engine, complete with oiling system, 5 years old.

1 Fairbanks-Morse Gas producer, complete for above.

1 30 K.W. 1,000 volt, 133 cycle single phase Royal Electric Generator, complete with exciter.

1 set of line shafting, complete with pulleys, clutches and belts.

1 marble panel switchboard with control equipment for generator and exciter.

1 Bulldozer Power Pump.

1 Duplex Plunger Pump.

1 Water Motor.

JOSEPH KNOX,
Stayner, Ontario.

Car Ventilating Systems

The Cooke System of Mechanical Car Ventilation. Specifications and estimates furnished. Manufactured in Canada under Canadian Patent 128070. Vacuum Car Ventilating Co., 561 W. Monroe Street, Chicago, Ill. 11 t.f.

For Sale

1500-light Dynamo, Exciter and Marble Switchboard, equipped with all attachments and instruments, all in first-class condition, for sale cheap; also one 13-inch LeFell Water Wheel, brass buckets, with wheel case, spur wheel and pinion. Box 819, Electrical News, Toronto, Ont.

FOR SALE

Lights		Speed
2	450 Gen. Elec. type C. form T, direct-connected to Curtis form A non-condensing turbine, 100 lbs. pressure, 25 kw., 125 volt.	3600
2	450 Gen. Elec., 6-pole, form L, 25 kw., direct-connected to Westinghouse vertical gasoline engines	350
1	540 Gen. Elec., 6 pole, form F, comp., 30 kw. direct-connected to 11 x 8 in. Gen. Elec. vertical marine type engine, 125 volt	305
1	1300 Northern, MP, 75 kw., comp., direct-connected to Racine vertical cross comp. engine, 125 volt	275
1	1300 Westinghouse, 6-pole, comp., 75 kw., direct connected to 14 x 14 Ames auto, center-crank horizontal engine, 125 volt	275

Send for our "Monthly Bargain Sheet" showing complete list of machines on hand with net prices. Every machine sold is completely overhauled and fully tested at our works before shipment, and is sent out practically "as good as new."

We Buy, Sell, Rent, Exchange and Repair.

GREGORY ELECTRIC CO.
CHICAGO, ILLINOIS
Established 1893.
1601 S. Lincoln Street. 11-t.

CITY OF MONTREAL

Notice to Contractors

Contract No. 2

Tenders for the Construction of a System of Underground Conduits, Manholes, Transformer Chambers, etc.

Sealed tenders in an envelope provided for the purpose, and addressed to the undersigned secretary of the Board of City Commissioners, will be received at the offices of the said Commissioners, City Hall, Montreal, in the Province of Quebec, until twelve o'clock noon, on the 15th day of August, 1912, for the construction of a system of Underground Conduits, Main and Service Manholes, Transformer Chambers, etc., in, upon, and adjoining that portion of St. Catherine Street, between Atwater Ave. and Guy St., in the City of Montreal.

Tenders will be considered for the whole and not for a part only of the above mentioned works, and persons tendering are notified that tenders will not be considered unless made on the printed forms supplied by the Commissioners.

Plans, specifications and forms of tender may be obtained at the office of the Electrical Commission, 1009 New Birks Bldg, any day during office hours, upon payment of a deposit of One Hundred Dollars, which amount will be refunded after the receipt of a bona fide tender and the return of the said plans, specifications and other documents.

Each tender must be signed and sealed by all the parties to the tender, and duly witnessed, and be accompanied by an accepted cheque on a Chartered Bank of the Dominion of Canada, payable at Montreal to the City Treasurer, for a sum of Five Thousand Dollars ($5,000) to be increased (if required) before the contract is signed by the accepted tenderer to an amount equal to ten per cent. (10 p.c.) of the amount of his tender.

The person or firm whose tender is accepted shall, within ten days after the final acceptance thereof, sign the contract, specifications, and other documents required to be signed, and in case of the refusal or failure on the part of the person or firm whose tender is accepted, to complete and execute the contract with the City Commissioners, the said cheque shall be forfeited to the City Commissioners as liquidated damages for such refusal or failure, and all contract rights acquired by the acceptance of the tender shall be forfeited.

The cheque deposited by the person or firm whose tender is accepted will be deposited to the credit of the City of Montreal as security for the due and faithful performance of the contract according to its terms.

The cheque deposited by the person or firm whose tender is rejected will be returned within ten days after the signing of the contract.

The lowest or any tender will not necessarily be accepted.

By order,

L. A. HERDT, Chairman,
The Electrical Commission of the City of Montreal.

L. N. SENECAL, Secretary.
Board of City Commissioners.

Newspapers inserting this advertisement without authority will not be paid for it.

Nernst Lamp Scrap Parts

We purchase for cash Heater Tubes, Glower Ends, Burners and all kinds of Scrap Gold, Silver and Platinum. National Refining Co., Ltd., 81 Peter Street, Toronto. 13-14-16-18-20

Situations Wanted

Electrical Engineer, single, age 28, desires change. Seven years construction and maintenance work, Generators, Switchboards, Transmission lines, etc. Box 821, Electrical News, Toronto, Ont. 13-14

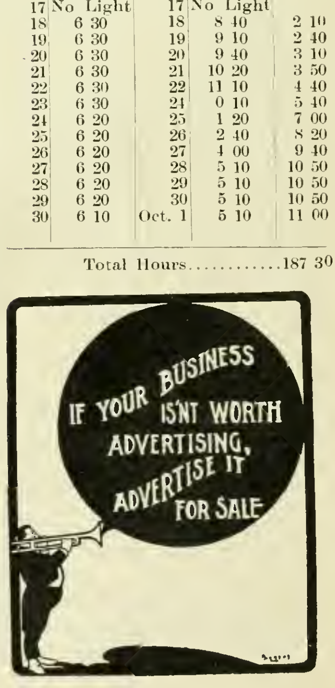
Position Wanted—Engineer, electrical and mechanical, age 26, with extensive workshop experience and University training, desires suitable engagement; more particularly on the sales staff. References. Box 851, Electrical News, Toronto, Ont. 16-17

Moonlight Schedule for September 1913

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
Sep. 1	7 00	Sep. 2	4 50	9 50
2	7 00	3	4 50	9 50
3	7 00	4	4 50	9 50
4	7 00	5	4 50	9 50
5	7 00	6	4 50	9 50
6	6 50	7	4 50	10 00
7	6 50	8	4 50	10 00
8	6 50	9	4 50	10 00
9	11 00	10	5 00	6 00
11	0 00	11	5 00	5 00
12	1 10	12	5 00	3 50
13	2 10	13	5 00	2 50
14	No Light	14	No Light	
15	No Light	15	No Light	
16	No Light	16	No Light	
17	No Light	17	No Light	
18	6 30	18	8 40	2 10
19	6 30	19	9 10	2 40
20	6 30	20	9 40	3 10
21	6 30	21	10 20	3 50
22	6 30	22	11 10	4 40
23	6 30	24	0 10	5 40
24	6 20	25	1 20	7 00
25	6 20	26	2 40	8 20
26	6 20	27	4 00	9 40
27	6 20	28	5 10	10 50
28	6 20	29	5 10	10 50
29	6 20	30	5 10	10 50
30	6 10	Oct. 1	5 10	11 00

Total Hours............187 30



Electrical News
Generation, Transmission and Application of Electricity

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Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 22 Toronto, September 1, 1913 No. 17

Present Hydro Extensions

That the extension demands on the Hydro-electric Power Commission of Ontario are showing no signs of abatement is indicated by the quantity of construction work at present under way at different points in Ontario. In the south-west section, the work includes capacity extensions at the Niagara Falls step up transforming station, the base of supplies, from the original 50,000 to about 75,000 h.p.; additions to the main switching station at Dundas, made immediately necessary by the requirements of the new St. Thomas to Windsor territory; additions also to the London and St. Thomas stations and the construction of new step-down sub-stations at Chatham and Windsor. For the two latter the equipment has been under construction for some months and the contracts for the buildings will be let in a few days. Work on the Brantford sub-station is also nearing completion. Line work in progress includes stringing the second circuit along the towers between Dundas and St. Thomas by way of Brantford and the construction of a new double circuit line between St. Thomas and Windsor. It will be remembered that the original towers between Dundas and St. Thomas were designed for a double circuit, but up to the present time only one circuit has been installed. The second circuit now being run from Dundas to St. Thomas is of aluminium cable, steel cored, this being the first instance of its use in Canada, though this type of cable has proven itself reliable over several years' operations in the United States. Between St. Thomas and Windsor the high tension line will be of copper. Considerable progress has been made on the new line west of Chatham, the tower footings being nearly all in place. When this section is completed the entire force will be set to work between Chatham and St. Thomas. All this work is being done by the Commission, no contractors being employed.

A 26,400 volt line is also being run out from Stratford to feed Clinton and Goderich where sub-stations are at present under way.

That the Commission has been able to carry on this work with undiminished vigor and at the time time take care of the frequent troubles it has recently had with its defective insulators, speaks well for chief engineer Gaby's organization. Since the beginning of the trouble, insulators on practically the whole line have been tested, and where necessary, replaced. In this connection it is interesting to note that the Commission's engineers have devised an apparatus for testing the insulators in service. This is an exceedingly valuable innovation in the matter of line testing, and we understand it is the Commission's intention to keep this testing equipment continuously at work on the line. This should go a long way towards preventing a recurrence of the insulator troubles which have bothered so many systems during the present summer.

In Eastern Ontario where power has been purchased from the Morrisburg Light & Power Company, a 25,000 volt transmission line is nearing completion to Prescott, 22 miles distant, and a sub-station of about 1,000 h.p. capacity is being erected at Preston.

In the Severn district a hydro-electric installation at Wasdell's Falls will be completed with all reasonable haste to supply the towns and villages in that neighborhood.

In addition to this, railway schemes and many other distribution extensions are either in course of erection or are being considered by the Commission's engineers. To all appearance there is little sign of any let-up in this Government undertaking. The total load is increasing quite beyond the expectations of the most sanguine of the original supporters and the demand threatens to become so urgent in the near future that in all reasonable probability the original contract for a maximum of 100,000 h.p., which looked so impossible five years ago, will have become a necessity.

Illustrated Articles

The matter of the best type of illustrations to reproduce in connection with the various descriptive articles in trade magazines is one which possibly permits of discussion, but the Electrical News is of the opinion that photographs of a purely pictorial character, so generally used, have much less educative value than, for example, plans, diagrams, etc., which indicate, in some part at least, the point of view of the designing engineer, the difficulties to be overcome and this particular engineer's method of overcoming them. Pictorial reproductions, such as the exterior of a building, or a too complicated interior are almost without value for educative purposes. The use of such a large number of this type of illustrations is accounted for, doubtless, by the fact that they add to the good appearance of articles which, further, are often written by men who are more or less closely associated with the installation being described and so, from their very familiarity with the equipment, see much more in the pictures than the readers of the articles can hope to. Or again, a reproduction of a switchboard, back or front, or a layout of generators or motors may show a "pretty" piece of work of the author himself which naturally he likes to see published, however complicated the work, or poor the photograph, may be.

In endeavoring to keep the helpful and educative features more and more prominent in our pages the Electrical News commends the above suggestions to the consideration of its readers and especially to all those who contribute items or articles for reproduction. The more practical the ideas are, the more value they will have for other electrical men. The Electrical News aims to be more than a "news" medium. Through our own efforts and our readers' assistance we hope

to make our magazine increasingly valuable as a medium of reliable "information" on all electrical matters.

Amendment to Regulations

An amendment to the regulations governing the granting of water power rights in Dominion Forest Reserves and parks has just been passed by an order-in-council giving power to the Minister of the Interior to lease water-powers which have a development of not more than 200 h.p., the leases to run for ten years, but renewable at the discretion of the Minister. The object of amending the regulations is to allow farmers, private householders, or owners of a small sawmill or such like to harness small waterfalls in the district in which they live, for the development of electric power. The order-in-council as passed reads as follows:

Whereas water power regulations governing the mode of granting water power rights in the provinces of Manitoba, Saskatchewan and Alberta, and in the Northwest Territories, were approved by Orders in Council dated 2nd June, 1909, 8th June, 1909, 20th April, 1910, 24th January, 1911, and 12th August, 1911, and these regulations were, by Order-in-Council dated 6th June, 1911, made applicable to all Dominion Forest Reserves and Parks;

And whereas these water power regulations are not suitable for the authorization of small water power developments of less capacity than 200 horse-power;

And whereas there are many applications before the Department of the Interior for the right to develop such small water powers,—

Therefore His Excellency the Administrator in Council, pursuant to subsection 2 of section 35 of The Dominion Lands Act and to subsection b of section 17 of the Dominion Forest Reserves and Parks Act, is pleased to order that the present Water Power Regulations, hereinbefore referred to, shall be and the same are hereby amended by the addition of a new section numbered twelve (12) as follows:—

(12).—If upon receipt and consideration of the information set out in sections 2, 3, 4 and 5, the water power to be developed is found to have no greater capacity than 200 horse-power at the average low stage of water, the Minister may issue a lease and a license, as may be required, authorizing the development of the proposed power; the lease and license to be for a period of ten years, subject to such special terms and conditions as may be considered advisable in each particular case ,and renewable if in the opinion of the Minister the power has been continuously and beneficially used.

Underground Work at Ottawa

The Department of Public Works, Ottawa, Ont., have called for tenders for underground services for the Parliament Buildings, Eastern and Western Blocks, and Supreme Court, Ottawa, which is to include vitrified clay conduit, hand holes, man holes, iron pipe, cable, cable racks, pot heads, junction boxes, etc., and everything necessary to insure a complete underground system. Four-duct conduit are to be installed, extending from a manhole now installed on Wellington street opposite the east gate around Parliament Hill to Bank street, with manholes and handholes. Ducts are to be laid at least 18 inches underground and enclosed in concrete at least 3 inches thick. Each joint is to be protected so that the concrete cannot filter through. Where the ducts are carried over the cliff at Supreme Court they are to be installed on a concrete bed at least three inches thick and enclosed in concrete of the same thickness.

The manholes are to have concrete sides at least eight inches thick and to have at least 5 feet 6 inches head-room. Handholes must have 5 inches concrete sides and be provided with metal covers checked into concrete, grouted with concrete, and made air-tight. Two stranded copper, paper insulated, lead covered cables are to be furnished and installed complete for main circuits; one 4-core, No. 2/0, B & S gauge for 2-phase a.c. circuits and one 2-core 300,000 c.m. for d.c. service. Branch cables for a.c. are to be 4-core, No. 4 B & S gauge, stranded copper, paper insulated lead covered; branch cables for d.c. to be 2-core, No. 3/0 B & S gauge, stranded copper, paper insulated lead covered.

Main and branch cables are to have paper insulation not less than 5/32 of an inch thick and lead sheath not less than 3/32 of an inch thick and must withstand a shop test pressure of 8,000 volts for thirty minutes. Alternative current cables must be designed for a working pressure of 3,200 volts; d.c. cables for 600 volts. The main cables in the manholes are to be connected to branch cables through an approved junction box to be furnished by the Department.

Report on Stream Measurements

The third of a series of reports on the progress of stream measurements in the provinces of Saskatchewan and Alberta, covering the year 1911, has just been distributed by the Department of the Interior. The report has been prepared under the direction of Mr. F. H. Peters, C.E., Commissioner of Irrigation, by Mr. P. M. Sauder, C.E., chief government hydrographer.

The chief features of the stream-measurement work are the collection of data relating to the flow of the surface waters and a study of the conditions affecting this flow. Information is also collected concerning the river profiles, duration and magnitude of floods, irrigation, water-power, storage, seepage, etc., which may be of use in hydrographic studies.

This information is obtained by a series of observations at regular gauging stations which are established at various points. The selection of sites for these gauging stations and their maintenance depend largely on the physical features and needs of the locality. If water is to be used for irrigation purposes the summer flow receives special attention; where it is required for power purposes, it becomes necessary to determine the minimum flow; if water is to be stored, information is obtained regarding the maximum flow. In all cases the duration of the different stages of the streams is noted. Throughout the country gauging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records in connection with short series of measurements will serve as bases for estimating the flow at other points in the drainage basin.

As the result of an increased appropriation the investigations were extended over a much larger territory during the past year. Considerable reconnoissance work was done and a number of new gaugaing stations were established. In the spring of 1911, field operations were commenced with 98 regular gauging stations and at present the regimen of flow is being studied at 132 regular gauging stations along the various streams in Alberta and Saskatchewan, records of the quantity of water diverted by thirty ditches for irrigation purposes are also being secured. Most of the stations on ditches were established by or at the request of the irrigation inspecting engineers. Winter records which are so valuable for power investigations have been given considerable attention lately and records have been secured on almost all the important streams in the two provinces during the past winter.

The methods of carrying on the investigations were similar to those of previous years. Local residents were engaged to observe the gauge-height at regular gauging stations. These observations were recorded in a book supplied by the Department, and at the end of each week the ob-

server copied the week's records on a postcard which was sent to the chief hydrographer by the first convenient mail. The district hydrographers made regular visits to the gauging stations usually once in every three weeks. They examined the observers' records, made discharge measurements and collected such information and data as would be of use in making estimates of the daily flow at the station. The results of the gaugings were transmitted by a postcard to the chief hydrographer. The records of the gauge-height observers and the hydrographers were copied from the post cards to regular forms in the office at Calgary and filed. At the close of the open-water season, part of the engineers returned to the office and assisted in the final computations and estimates of run-off. Gauge-height-area, gauge-height-mean-velocity, and gauge-height-discharge curves were plotted and rating tables constructed. Tables of discharge measurements, daily gauge-height and discharge, and monthly discharge were also compiled. These records have been recopied and are embodied in this, the third annual report of progress of stream measurements. The report also contains a number of interesting illustrations.

The World Wants This Man

By Berton Braley

We seek him everywhere
Amid the throng.
We've sought him here and there
And sought him long,
Hoping among the mob
He'll chance to dwell—
The man who knows his job
And does it well!

We know of labor's woes,
Nor hold them light,
But ah, the man who knows
His business—right!
Workman, or cop, or clerk—
He makes a hit,
The man who knows his work
And tends to it!

The world has constant use
For men like this.
Who's work's not fast and loose
And hit or miss.
It seeks, with heart athrob,
Where he may dwell—
The man who knows his job
And does it well.

The Conservation of Our Water Powers

The Commission of Conservation have just issued their fourth annual report on the progress of investigation into the natural resources of our Dominion. The report includes contributions by Mr. Leo. G. Denis and Mr. Arthur V. White concerning work done by them in connection with the collection of water power data at different points in Canada. These latter reports are written in the form of a condensed diary which makes almost as interesting reading as the log-books of Stanley, Nansen, Shackleton, Scott, and other explorers of unknown regions. The only difficulty is that the information is as yet too meagre. There is enough, however, to indicate that the work of these engineers is along lines which are certain to give, ultimately, valuable and far-reaching results, showing that the Commission have been well advised in the type of work they are undertaking. That the results will come slowly is only to be expected, as the field of investigation is large, the work is onerous, and the funds available are not unlimited. Apparently however, the government is prepared to deal fairly liberally in the latter respect, a course with which we entirely agree, for, quite aside from the immediate monetary value of accurate knowledge about our water powers, the definite assurance of their actual magnitude will give our Dominion a considerable added prestige among the other nations of the world. Copious extracts from the reports of Messrs. Denis and White are printed elsewhere in this issue.

Electrification of New Birks Bldg.

A Description of the Equipment in Vancouver's Handsomest Office Building

When completed the Birks Block, Vancouver's newest and handsomest office building, situated at the corner of Georgia and Granville streets, will possess electrical equipments superior to any previously installed in a local building of this class. The structure on its two street frontages measures 100 x 120 feet, and comprises 10 storeys with a basement and sub-basement. The sub-basement is utilized for the heating plant which consists of two high pressure boilers burning oil fuel. The basement, ground floor and about three-quarters of the space on the first floor will be occupied by the well-known jewelry firm of Henry Birks & Sons, Limited. The firm's show rooms, packing rooms, buyers' rooms, optical grinding department, large transformer room and lockers for employees are all contained in the basement. The retail jewelry premises will occupy the entire ground floor space, the watch repairing department, jewelry manufacturing and repairing department, mailing room, men's lockers, women's lockers and rest rooms being located on the first floor.

The floors above the first storey will be used for general offices of various dimensions. The light and power throughout the building, which will be supplied by the B. C. Electric Railway Company, consists of 500 volts d.c. and 220 volts, 3-phase and 220 and 110 volts single phase. The 220 and 110 single phase will be used for lighting purposes, while the 220 volt, 3-phase will take care of the power supply, exclusive of the current required for the elevators, four in number, which will be operated by 550 volt d.c.

The wires for the lighting service consist of nine 700,000 c.m. cable in three pairs of three each, in three separate runs placed in 4-inch conduits, and the power service is two 300,000 c.m. cable. The 3-phase is made up of three No. 4/0 cable.

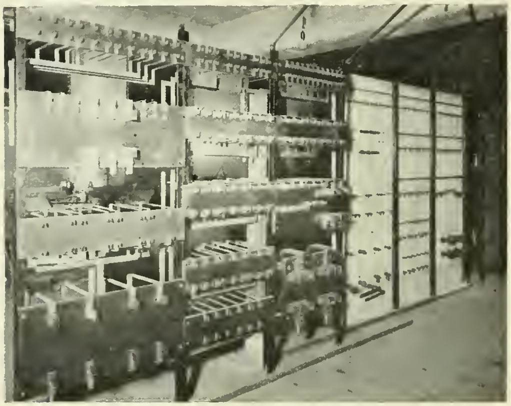
The switchboard controlling the light and power was manufactured by A. R. Coutts & Company, Vancouver. The width of the board is 9 feet, 7 inches, and the height 7 feet. There are three panels of blue Italian marble, consisting of two lighting panels and one power panel The switches are all back connected, and the fuses and buzzing equipments are mounted on a separate rack, which is set 18 inches from the rear of the marble panels. All conduits terminate in a concrete pit at the back of the switchboard, and the wires are carried to the various switches on the board in such a manner as to make them accessible at all times. This concrete pit is drained and has a plate glass covering 1½ inches thick, which covers the entire floor at the rear of the board The outstanding feature of the latter equipment is the absolute safety which is assured in operating the switchboard or changing the fuses. By means of the glass covering, an inspector is enabled to note the condition of the pit at a glance, besides which the appearance of the equipment is much improved by the arrangement.

A large number of small d.c. motors of various sizes will be used in the manufacturing and repairing of jewelry and in the optical grinding department of the Birks establishment, and there will also be an ash hoist, dumb waiter and a ventilating system throughout, all electrically operated. The building will be cleaned by a portable vacuum process,

current being obtained from receptacles on the various floors. For the operation of a pneumatic cash tube system in the jewelry store there will be a three h.p. motor, and two small motore will be used for sump pumps in the sub-basement.

Altogether there will be 26 panels installed on the different floors. All corridors, toilets and janitor's quarters are controlled by two cabinets, one on the third and the other in the seventh floor, and each floor renting space has a cabinet which is controlled separately from the main switchboard in the basement.

The exterior illumination of the building consists of 120-100 watt tungsten lamps, placed between the medallions in the cornice. This is controlled by a separate cabinet on the ninth floor. Apart from the lighting in the upper portion of the building, there are 170 lighting circuits on the ground floor to provide interior illumination for the jewelry store. Frinck invisible reflectors are being used in the show cases. The lighting of the 200 feet of window space in the store is controlled by two time switches operated in such a manner that one-half of each window may be illuminated on dull days. All light and power, telephone and messenger service wires are run in sherardized metal conduit varying in size from one-half inch to four inches. This equipment was manufactured by the National Metal Moulding Company. Upwards of 60,000 feet of conduit and 175,-000 feet of wire have been used altogether.



Rear of switchboard, buzzing and fuse rack.

Two ceiling outlets and two wall plugs are provided in each office, the majority of single offices having 150 square feet of floor space. Each office is controlled by an H. and H. switch placed in the entrance door casing at a height of four feet from the floor, and the wall receptacles are of Hubbell No. 5418. All offices facing on Georgia and Granville streets, from the first floor to the fifth floor, are specially equipped to suit doctors and dentists, having extra receptacles for dental engines and X-ray equipments. These offices were all rented en-suite before the building was completed and the contractors were required in most instances to install equipment suited to the individual wishes of each tenant.

All the duplex wire used in the building was supplied by the Standard Underground Cable Company, of Hamilton, Ont., and the larger sized wires were supplied by the Canadian General Electric Company.

The telephone system consists of a service of 330 pair, 30 pairs of which are used for a private exchange in Henry Birks & Sons store, and 300 pairs for the service in the remainder of the building, the latter being run in lead sheathed cable up a pipe shaft and splices made on the third and seventh floors where branch cables of 30 pair are connected to the main cable and run to each separate floor. This 30 pair is run to a strip box on each floor, and from there, No. 19 twisted pair is run in a wire moulding through the corridors and through a conduit bushing to the various offices. There is also a messenger system throughout which is run in conduits.

In connection with the elevator system special mention must be made of an automatic signal system to be installed in connection therewith, which will automatically give a signal to the elevator operators when it is time to leave the upper and lower limits of travel. This system is manufactured under patents issued by Mr. Roy Griswold, of Seattle, Wash., and operates as follows: When two cars only are running, either car reaching the top floor signals the other car at or nearing the bottom to start upward, which in turn signals the car at or nearing the top to start downward. When traffic demands the third car to begin running, the operator by closing a switch places the system in readiness for three cars, and starts his car in either direction of travel without notifying the other two operators. Any car travelling downward at a pre-determined point signals any car at or nearing the main floor to start upward. This car in its upward travel at a pre-determined point, signals either of the other cars, which is at or nearing top floor, to start downward. In the same manner the fourth car is put in operation by closing a switch. These switches are accessible to all operators; thus any car can be started or stopped without notifying the operators of other cars, as changing the switch causes signals to be given to suit condition of the number of cars running.

The firm of NePage, McKenny & Company, electrical engineers and contractors, Vancouver, is in charge of the electrical installation throughout the building. Mr. E. G. Mundy, the local manager, is personally supervising all work. This company is credited with being the largest electrical contracting concern on the Pacific coast, with branches at San Francisco, Portland, Spokane, Seattle, Vancouver and Victoria, and among the important contracts awarded recently being the L. C. Smith Building, Seattle, Wash., a forty-two storey structure; the Devonport Hotel in Spokane, costing one and a half million dollars, and the fifteen storey Weart Building in Vancouver.

Canada's Latent Water-powers

A Brief Report on the Results of Recent Investigation Work in the Prairie Provinces

By Mr. Leo. G. Denis

During the first part of the year a large amount of time was devoted to a report on the Waterworks of Canada. The information which had already been obtained by correspondence was supplemented and brought to date. In some instances, to accomplish this, it was necessary to visit several towns in Ontario and Quebec and obtain from them data which could not be obtained by correspondence. This report is now in the printer's hands and will be ready for distribution in a short time. It contains a summary description of the waterworks systems of Canada, all arranged for ready reference. A portion of the report is devoted to charts and tables emphasising points of special interest, such as increase in the number of water-supply systems, rates, sources of supply, consumption per capita and sewerage conditions.

Water-Powers of Western Canada

To obtain further information for the proposed report on Western water-powers, a trip was made to the northern portions of the provinces of Alberta and Saskatchewan, to investigate water-power possibilities. The principal rivers

travelled over were the Peace, Slave, Clearwater, Methy and Beaver.

I left Ottawa on June 16th and reached Edmonton on the 19th. I found that the Hudson's Bay Company's steamer was only due to leave Peace River Crossing for Hudson's Hope, my first objective point, on July 10th. From Edmonton, where railway travel was abandoned, until the Canadian Northern Railway was reached at Big River, I travelled a total distance of 2,100 miles, of which 1,000 were by river steamers, 850 by canoe, and 250 overland, where the mode of transportation varied from automobiling to footing it behind a team of oxen.

Peace River Canyon

I left Edmonton on June 25th, passing through Athabaska Landing, thence by steamer and stage to Grouard and Peace River Crossing, arriving at the Crossing on July 3rd. I left for Hudsons Hope on July 17th, arriving at the latter place on July 25th. As a very complete survey of the Peace River canon had been made during the previous summer by Mr. G. B. Milligan, it was not necessary to make the proposed survey, Mr. Milligan kindly supplying a plan of his survey. As no levels had been taken, however, the portage was traversed to the upper end of the canyon, aneroid readings were taken for difference of levels and the canyon was explored for a few miles at each end. The descent of the water in the canyon is fairly uniform, except near the head where there is a descent of 25 feet in a half mile. The total descent from head to foot is 225 feet in 18 miles.

Vermilion Fall and Rapid

Leaving Hudsons Hope by steamer on July 27th, Fort Vermilion was reached on August 1st. Here men were secured and on August 5th we started down the river for Fort Smith. Next day the Vermilion fall and rapid were measured. The descent in the rapids is 14 feet, while that in the chute is 12 feet, giving a total of 26 feet in a distance of 1¾ mile.

The Boyer or Little rapid was measured on the 9th, and we reached the mouth of the Peace river on the 11th and Smith Landing on the 13th. During the whole trip from Fort Vermilion we were much delayed by heavy head winds and, at times, had to "track" in spite of the fact that we were

At Smith Landing, I found that, to level the descents between that point and Fort Smith, it was necessary to run the rapids, as, from the Sixteen-mile portage road, the river is inaccessible, except in a very few places. I accordingly hired a local guide and started down the rapids. The channel followed for the greater portion of the distance lies between the numerous islands on the east side of the river and the descent is effected by short pitches, some of which have to be passed by portages. In passing the last pitch of the last rapid, I had the misfortune of having my boat upset, losing several instruments and some personal effects. The whole trip through these rapids, including the time spent in taking observations and levels, took almost two days, after which I returned from Fort Smith to Smith Landing by the portage road.

Rapids of Slave River

The following are the descents observed in each of the five rapids:

Cassette rapid	27 feet
Second rapid	37 feet
Mountain rapid	25 feet
Pelican rapid	10 feet
Drowned rapid	13 feet

The total descent in the 16 miles where these rapids occur, including the swift waters between them, is about 135 ft.

I left Smith Landing by the Hudson's Bay Company's steamer Grahame on August 20th and arrived at Fort Chipewyan on the 22nd. Men with provisions and a canoe, who had been sent from Athabaska Landing by my instructions, were waiting for me. Next day, we started by canoe up the Athabaska river, reaching Fort McMurray on September 1st. On the following day, we proceeded up the Clearwater river and reached Methy portage on the 9th. The Clearwater was metered at the Cascades rapid and the descent in the Cascade, Le Bon, Bigstone and Pine rapids and in the Whitemud fall were levelled.

Rapids of Clearwater River

The following is the descent observed in these different rapids.

Cascades rapid	16 feet
Le Bon rapid	31 feet
Big Stone rapid	6½ feet
Pine rapid	21 feet
Whitemud fall	41 feet

Beaver River

I sent men over to the other side of the Methy portage for a team of oxen to portage our canoe and provisions and, after unavoidable delay, we finally reached the Hudson's Bay Company's post on Methy lake on the 12th and proceeded down Methy lake and river. The rapids were levelled and the river was metered above the mouth of the Whitefish river. We then crossed Buffalo lake and reached Ile-a-la-Crosse post on September 21st. Here, after purchasing some provisions we started on our way up the Beaver river on the same day, reaching the Grand rapid on September 24th, where levels were taken and the flow of the river metered. We continued ascending the Beaver river and by way of Cowan river and lake reached Big river on September 28th. We had to wait until October 1st for a train to take us to Prince Albert, which was reached on the same day. From Prince Albert, I sent the canoemen back to Athabaska Landing and left for Ottawa, where I arrived on October 6th.

Water-powers of British Columbia

Good Progress Made in the Investigations—Work of a Difficult Nature—A Brief Review

By Mr. Arthur V. White

In presenting a review of the work appertaining to water powers done under my direction during the season of 1912, I desire to point out, first of all, that the main work in hand is the collection of information respecting the water-powers of British Columbia, with the object of enabling the Commission of Conservation to publish a report dealing with the water power resources of Western Canada.

Complicated Situation

No other province of Canada is confronted with the problem of adjusting so complex a water situation as exists in British Columbia. In the early 'fifties,' water rights and privileges for mining operations began to be taken up, and, subsequently, other rights and privileges were granted for irrigation in connection with the development of large agricultural areas. All of these rights are now represented by upwards of 5,000 water records, issued under various terms and conditions. In addition, there are others, given later, for water-powers. The application for waters for all purposes are on the increase. The whole situation is a difficult one, and, until adjudication upon conflicting interests can be had, patience and consideration will be required on the part of the record-holders, and caution, wisdom and courage on the part of the administration. These problems are now being dealt with by the Provincial Government, and, in this connection, two men, experienced in irrigation and water matters in the United States, Dr. Samuel Fortier and Mr. H. W. Grunsky, were, during a part of 1912, engaged in

considering ways and means of satisfactorily adjusting some of these problems.

Provincial Co-operation

When I arrived in British Columbia I found that the plans outlined for 1912, contemplating as they did a measure of co-operation on the part of the province with the Commission of Conservation, required some modification. Hon. William R. Ross, Minister of the Department of Lands, said that he desired to extend to the Commission any assistance he could and suggested that I confer with Dr. Fortier and others. A conference was held, and as our plans did not conflict with their work, the Minister's co-operation was extended, the province advancing $3,450 to cover their portion of the co-operative work. In the United States, much water investigation work is carried on co-operatively between the Federal and State authorities. For example, during the fiscal year 1912, the Water Resources Branch of the United States Geological Survey received for such co-operative work, from the state authorities of California, $25,500; from Minnesota, $16,000; from New York and Oregon, each over $13,000; from Idaho, $12,500, and from Washington, $4,400; while a number of other states contributed lesser sums. All the contributing states thus gave a total of nearly $114,000, and this co-operation has proved of mutual benefit. During 1913, it is expected that a further special appropriation will be made by British Columbia, probably larger than that of 1912.

It might add a little to the clearness of what I am about to say, if I explain what authorities exercise jurisdiction over water-powers in British Columbia. First there is the Water-power Branch of the Department of the Interior, which has jurisdiction over the Railway Belt. In addition, the Department of Lands of British Columbia has a Water Branch which deals with irrigation, and also a separate Lands Department dealing with water-powers, which reports direct to the Minister.

Railway Belt Water-Powers

In the report of the third annual meeting of this Commission, it is stated that in initiating the water-power investigation in British Columbia it was decided to begin systematically to cover the territorial area of the province. The area south of the Railway Belt, together with the Railway Belt itself contains the bulk of the population of the province; it also comprises the water power possibilities of more immediate economic importance, and, consequently, the investigation was commenced in these districts. A large part of the Province south of the Railway Belt, in 1911, was examined by the engineers of the Commission.

Through the courtesy of the Water-power Branch of the Department of the Interior, the hydrographer of the Railway Belt, Mr. P. A. Carson, has, during 1912, carried forward an investigation in his territory, and the principal field data respecting the water-powers in this area have been assembled. I understand most of these data have been reduced to a form readily adaptable for inclusion in the proposed water-power report. We are indebted to Mr. Carson, and his engineers, Messrs. C. G. Cline, C. E. Richardson, E. M. Dann and H. S. Keys for their assistance and also to Mr. J. B. Challies, Superintendent of the Water-power Branch. The Kamloops hydrographic office has had a heavy task with its own irrigation and other work, and notwithstanding this, extra effort was made by its staff to further the early collection of water-power information that had been requested. They have secured hydrographic data, including measurements of stream flow, for some of the large rivers, such as the Fraser, the North Thompson, the South Thompson, the Columbia, and the Adams.

Columbia River Survey

The Department of Public Works, Canada, in 1912, commenced an instrumental survey of the Columbia river around the "Big Bend." Through the courtesy of the Department, and the district engineer directing the survey, Mr. F. W. Aylmer, it was arranged that the Commission of Conservation might attach a man to this survey party, that he might make water-power investigations of the tributaries of the Columbia, using the main survey party as a base for operations. Meantime, however, a new water-power organization had been effected in the Lands Branch at Victoria, and Mr. G. Gray Donald was placed in charge of water-power work. As he desired to make some surveys on the Columbia, it was left for him to avail himself of any co-operation with Mr. Aylmer's party that might seem desirable. Mr. Gray Donald also commenced instrumental surveys of the Pend'Oreille and Kootenay rivers and the results will, later, be available for our report upon the water-powers of Western Canada.

Forests Branch Co-operation

The Forests Branch of British Columbia has just organized an extensive, systematic survey of the forests of the Province, and the chief forester, Mr. H. R. McMillan, has arranged to have the skilled men engaged upon this special survey, report specifically upon water-powers observed, if, after trial, such work is found not to hinder the progress of his own surveys. Mr. H. K. Robinson, who is initiating this forest survey work in the field, informed me that his assistants seemed much interested in the water situation, and were ready to co-operate in supplementing their forest reports with data relating to water-powers.

Co-operation of Surveyor-General

The Surveyor-General of the province, Mr. G. H. Dawson, has instructed British Columbia land surveyors who are executing the provincial land surveys, to send in information relating to water-powers. It is to be supplied upon special forms which, however, are not returnable to the Surveyor-General until later in the year, when the surveyors are handing in their survey reports. We are also indebted to the chief geographer, Mr. G. G. Aitken, who has very kindly assisted us with blue prints, and with advance copies of the new map of British Columbia.

Co-operation of Waters Branch

In the Waters Branch, B.C., through the courtesy of the Acting Chief Comptroller, Mr. J. F. Armstrong, there is now being compiled a complete, brief tabular synopsis of all the records and water reservations issued in the Province. These water records, as above intimated, constitute really the underlying basis of the water situation and, in many cases, they conflict with the possible development of power on streams to which they appertain. This tabulation will be available for our proposed report, and will constitute a valuable basic record.

Electric Inspection Branch Co-operation

The Electric Energy Inspection Branch of the Department of the Attorney General of British Columbia, under the superintendence of Mr. D. P. Roberts is co-operating to secure some desirable information relating to the hydro-electric power companies now operating in the province.

Survey of North Thompson

During 1912, a firm of engineers were conducting a railway survey and taking levels down the North Thompson. It was not possible to send a party into this territory, but through the kindness of one of the members of the firm, data was obtained respecting tributaries of the North Thompson. This work was done for a nominal sum.

Data from United States Surveys

In January, 1913, while in Washington, D.C., at the conference of District Engineers engaged upon stream gauging in the United States, I met the engineers who are conducting water-power investigations in Idaho, Montana and Washington. A considerable body of data will later be available from the investigations of these engineers; especially as a

result of the work of 1913. The state of Washington, for example, will investigate the rivers in the portion of the State adjoining British Columbia and the results will be available for our report. They will be valuable since they are derived from territory corresponding in physical characteristics to portions of British Columbia.

Field Operations in 1912

Our own field work in 1912 was commenced in early July in the Cariboo district. Engineers G. H. Ferguson, A. W. Campbell, C. J. Vick, L. G. Mills, and F. Burd outfitted with pack horses and supplies at Quesnel. Mr. Ferguson's previous experience facilitated the securing of horses—an expensive factor of survey cost—at a reasonable rate. Messrs. Campbell and Vick were each in charge of a sub station of the work, while Messrs. Mills and Burd acted in the capacity of assistants. A very considerable amount of territory embracing the tributaries of the Fraser river to as far north as the Grand Trunk Pacific Railway, was covered. The major portion of the responsibility for this work was upon Mr. Ferguson, and his application contributed much to its success. Representative photographs were secured, those taken by Mr. Vick being especially good. In all about 3,300 miles were travelled by the Cariboo party.

Mainland Coast Survey

Two parties, each consisting of two men, were despatched up the mainland coast, beginning just north of Powell river. They were instructed to examine all streams entering the various inlets. A 40-foot gasoline launch, the "Lizette," was chartered, and outfitted for three months. I regret, however, that the measure of success attained by the West Coast party was not what I anticipated. While work on this coast is especially difficult, and the heavy rains make it necessary to operate under disagreeable and trying conditions, there is often, in such investigations, a temptation to hurry over the ground, although explicit instructions have been given that the work must be done in a thorough manner. Too much time was spent on the smaller streams and the larger ones were not followed far enough up from their mouths, and I now doubt the advisability of sending more than one party in one boat. The basic idea in planning the work was that one party would go up one stream, the other party up another, and the engineer would manoeuvre the launch to pick the men up with the least possible loss of time on their return. This interdependence of one party upon another may have had an undesirable influence upon the party that should have gone up their streams farther; and it may sometimes have been difficult to apportion the time to the respective parties. It is estimated that the coast party covered about 3,000 miles, much of which distance was necessitated by the trips in and out of the long inlets. However, considerable data was secured and the deficient information can probably be obtained by a couple of men using the steamers plying along the coast.

The season, during which it is profitable to carry on reconnaissance water-power investigations in British Columbia is comparatively short, and it is almost impossible for observers to avoid over-estimating the power possibilities of streams observed during high stages.

Assemblage of Data Requires Time

After drawing attention to these matters connected with work performed in British Columbia, and to the efforts being put forth by the various co-operating agencies named, it may erroneously be inferred that much more data is in hand than is actually the case. I have endeavored to outline the avenues along which efforts have been, and are being, directed in order to secure information, and to indicate the measure of success that has attended these efforts. The majority of persons from whom cognate information must come are pressed with their own matters, and it has been necessary for me to do a certain amount of personal co-operative work in order to secure their co-operation, and to manifest the desire of the Commission of Conservation to assume its own share of the labor of securing information. All these matters take time and the information may be, and often is, delayed. It must be appreciated, therefore, that much of the data above referred to is not yet in hand, but it is gradually coming in.

Suggested Surveys on Vancouver Island

I had hoped to examine some water-powers on Vancouver Island on which there are some important power streams, notably Campbell river, but funds did not permit. I have always felt that a territory so well confined, and relatively of such limited extent as the Island, should not be subjected to the class of reconnaissance investigation that would be justified for larger areas. In the United States, there is an increasing tendency to do preliminary work of investigation of power rivers in a more detailed manner; the streams are profiled, and possible dam sites, and storage reservoirs, are contoured. This results without undue increased cost—in the production of permanent survey records of enhanced value. I think that Vancouver Island presents an excellent opportunity to make an investigation of its rivers in a manner to yield data of a higher standard, and thus leave the work more complete, and an example of what may next be striven for in other parts of the country. I propose to discuss with the Minister of Lands for British Columbia, the possibility of conducting such a water-power survey on the Island, and to undertake at least a portion of this work along the lines just suggested.

In the northern portion of the state of Washington much greater outlay is now being made for water-power investigation and surveys, and it is especially desirable to make corresponding investigations in this country, especially upon waters which flow across the boundary. It is understood, of course, that good judgment is called for in the selecting of where, and in determining to what extent, such work should be performed.

Other Work

During the year I assisted in the preparation of the Chicago Drainage Canal report, and, prepared a report dealing with the Long Sault power project. In August, I returned to Ottawa, and spent September assisting upon work connected with the references before the International Joint Commission relating to a proposed regulation of the level of the Lake of the Woods. In this connection, I attended public hearings at International Falls and Warroad, Minnesota, and at Kenora, Ontario.

Plans for Work, 1913

In 1913, it is proposed to deal with the territory tributary to the Grand Trunk Pacific, and the Pacific and Great Eastern railways, along with the balance of the west coast, Vancouver Island, and probably part of the country lying well to the northward of the Grand Trunk Pacific Railway.

In 1912, due to the demands of travel, the work was necessarily more expensive than in 1911. Owing to increased freight rates and lack of competition, the prices for food and other supplies increase the farther inland one goes. Take, for example, the parties operating last year in the Cariboo district. The average cost of food per man per day for the Quesnel River investigation was 80 cents; for the Blackwater River district, $1.00; and for Willow and Bear rivers, $1.20. A fair average for food for this work would be $1.00 per man per day. Saddle horses ranged from $1.25 to $1.50 per day, and pack horses from $1.00 to $1.25 per day. For the most part, the horses grazed for themselves. Hay ranges in cost from $50 per ton upwards, and, in the Chilcotin district, oats cost from $1.00 to $1.35 per bushel. In 1913, I expect the field operations may be considerably more costly than in 1912.

New Plant of Dryden Timber and Power Co.

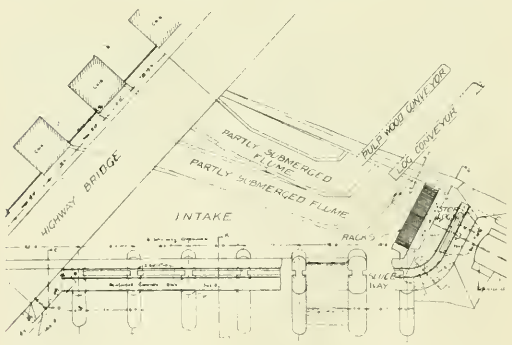
An Installation Possessing Several Unique Features in Design and Construction—Turbine Capacity of 2000 H. P.

A hydro-electric development of 2,000 horse power capacity has just recently been completed for the Dryden Timber & Power Company at Dryden, Ont. The power will be used for operating sulphite pulp mills of this company and for supplying light and power to the town. The plant is situated on the Wabigoon River at a point about one mile below Lake Wabigoon, and just opposite the town of Dryden, which is half way between Port Arthur and Winnipeg on the main line of the Canadian Pacific Railway.

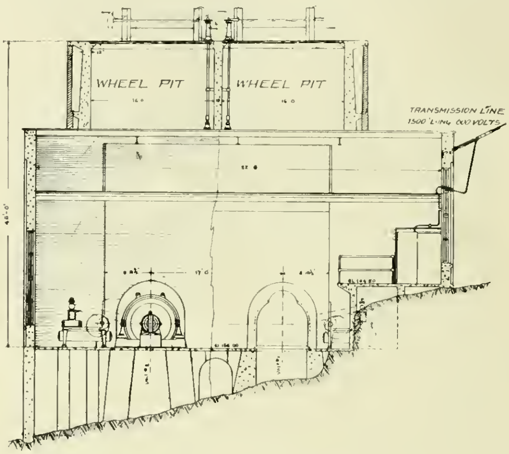
Lake Wabigoon has an area of some 60 square miles and constitutes a very desirable reservoir for this power development. The water shed area feeding this lake is in the neighborhood of 800 square miles. The river flow is about 400 c.f.s. The development is the result of utilizing three distinct falls which, in a distance of 1,600 feet have a total drop of about fifty feet.

The dam is of concrete, 120 feet long by approximately 25 feet high. It consists of a series of piers placed 16 foot centres with concrete spillways and stop logs between and with reinforced concrete slabs across the top, over which the winches operate on a built-in track. The dam is built at an angle across the river, providing ample spillway area to take care of surplus water in time of flood. A sluiceway is provided which can be opened to the full depth of the dam in case of extraordinary flood. The small forebay formed by the dam, diminishing in width towards the mouth of the pipe, serves also as an approach for the saw logs and pulp logs to the mill.

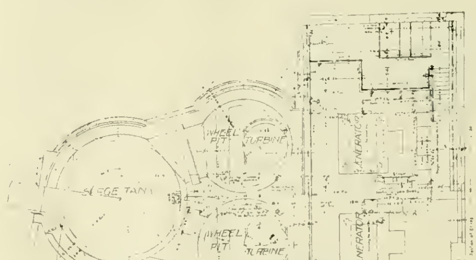
Just above this forebay the river widens out into a small lake which is part of Lake Wabigoon, and the entire season's cut of logs both for pulp and for lumber and ties is assembled here in booms. Across the entrance to the forebay is a series of cribs to which are attached the various booms by which the logs are controlled. Two partly submerged flumes, one for pulp logs and one for saw logs and ties, lead from this line of cribs, through the forebay, to chain conveyors situated near the entrance to the pipe, which lift the logs from the water and carry them to the mill. These flumes serve to guide the logs, and to keep bark and sticks or small pulp logs from approaching the racks. A steel thimble set in the concrete connects the dam with a wood stave pipe 1,500 feet long and 9 feet inside diameter. Stop logs and racks are, of course, placed in front of the pipe mouth. The pipe line is constructed of 4-in. x 8-in. B. C. fir, bevelled to shape. The bands are of 3/4-in. steel, spaced 9-in. apart. The pipe line is supported on wooden blocks spaced about 10 feet apart and for a distance of 200 or 300 feet rests on a wooden trestle at a height of 12 or 15 feet. In passing under the C. P. R. embankment a reinforced concrete pipe is substituted for the wood stave. The wall of the concrete pier is 12-in. thick, treated both inside and out with a waterproofing compound and a coating of asphalt. The pipe is laid on a grade of 0.266 per cent. sloping towards the power house. The design of the power house is shown in the accompanying figures in both plan and cross sections. An important feature is the surge tank and the two open wheel pits designed to secure good regulation. The tank and the wheel pits are built of reinforced concrete and are circular in shape, the surge tank being 22 feet diameter, and the wheel pits 16 feet each, grouped as shown in the drawing. Owing to the circular form of the tanks, there is no bending moment in the walls, and the stresses due to the head of water are taken up by



Dam, sluice-way, intake, submerged conveyors, etc.



Section of power house through generators.

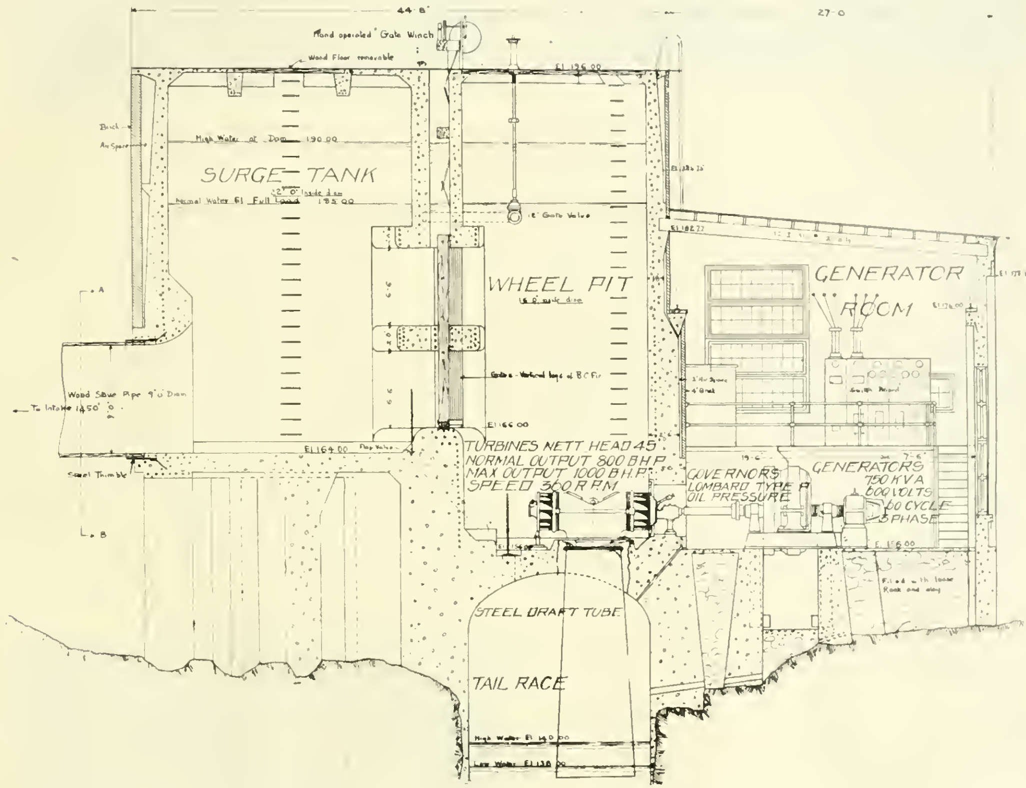


Showing general plan of Dryden power plant.

direct tension in the reinforcing steel, the concrete serving merely as an envelope to contain the water. This form of construction takes considerably less concrete and reinforcing steel than would be required in rectangular tanks. The walls of the tanks are 24-in. thick at the bottom and 12 in. at the top and 40 ft. in height. The velocity of the water entering the wheel pits is about 2 feet per second. The wheel pits may be isolated from the surge tank by the lowering of wooden gates composed of vertical timbers operated by hand winches.

The turbines are placed on the floor of the wheel pits which is about 18 feet above extreme low water and the fitted with covers for giving access to the runners and fitted with heavy cast iron foundation plate for setting in floor of turbine pit. Each turbine is fitted with a rivetted steel tapered suction tube 16 feet long with flange on the upper end for connection to the foundation plate and bell-mouthed at the lower end.

The governors are of the Lombard oil pressure quick acting returning relay type, complete with pressure and exhaust tank relay valve, main controlled cylinder, etc. They are fitted with high speed sensitive governor heads with suitable balanced piston valves for operating the relay valves and are of ample power to operate the regulating



Cross section showing surge tank, wheel-pit, turbine, generator, draft tube, etc.

water is carried off by two steel draft tubes which empty into the same tail race above which the wheel pits are supported on a concrete arch.

The turbines, of which there are two, are of the Francis twin central discharge open flume type, each designed for a working head of 45 feet and capable of developing 800 B.h.p. with a water supply of about 190 c.f.s. at 360 r.p.m. The turbines have a maximum capacity output of 1,000 B.h.p. Each unit is provided with two runners constructed with buckets of heavy flanged mild steel plates cast into a centre boss and surrounding ring of cast iron. Each runner is mounted inside a cast iron guide casing provided with a set of cast iron adjustable guide plates fitted on steel spindles. of cast iron adjustable guide plates fitted on steel spindles. The turbines are mounted on a cast iron sectional type central discharge casing provided with two large manholes guide blades in the turbines. The governors are capable of controlling the speed within the following limits:—

Ordinary gradual load changes—speed variation not to exceed 1½ per cent.

Twenty-five per cent. sudden change of load—speed variation not to exceed 3 per cent.

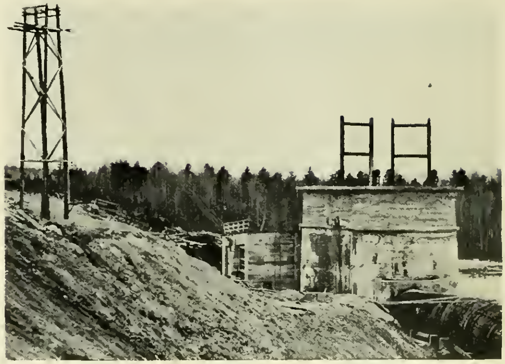
Fifty per cent. sudden change of load—speed variation not to exceed 6 per cent.

One hundred per cent. sudden change of load—speed variation not to exceed 16 per cent.

The fly wheel effect of each generator is 1,000 ft. tons at 360 r.p.m.

Two sets of independent triple oil pumps are provided for operating the governors, each arranged for belt driving from the turbine shaft and each set of sufficient capacity

Dryden power house—discharge side.



Intake side, also showing 4-pole tower.

for the proper operation of the two governors, if required.

The turbines are guaranteed to develop not less than a maximum of 1,000 B.h.p. each under an actual working head of 45 feet at 360 r.p.m., the efficiency of the turbines to be as follows: full load 81 per cent., 7/8 load, 85 per cent., 3/4 load 83 per cent., half load 75 per cent.

The generators are 3-phase, 60 cycles, 600 volts, 360 r.p.m., 750 kv.a. each, of the revolving field water wheel type. They are constructed on cast iron bed plates with two main pedestal bearings provided with ring lubricated bearings. Each generator is guaranteed to develop its rated output continuously with a temperature rise not exceeding 40 degrees C. and of developing 25 per cent. overload continuously with a temperature rise not exceeding 50 degrees C. and of developing 50 per cent. overload momentarily without danger. Each generator is provided with a direct-coupled exciter mounted on an extension of the main base plate, each exciter being large enough to feed both generators at full load. The efficiency at unity power factor is guaranteed as follows: ¼ load, 83.4 per cent.; half load, 90.5 per cent.; 3/4 load, 92.7 per cent.; full load, 93.5 per cent.; 1¼ load, 93.8 per cent. The regulation at unity power factor is 8 per cent. and at 80 per cent. power factor is 16 per cent.

The switchboard consists of five panels of black enamel slate mounted on an iron frame work. The two generator panels are each fitted with three ammeters; one triple pole oil break switch fitted with two maximum over load trip coils; one set of synchronous plugs; one set of volt meter plugs; one integrating watt meter; one double pole field switch and one alternator field regulator. The exciter panel is fitted with a volt meter; two sets of volt meter plugs; two double pole exciter switches; two field rheostats; one lighting switch; two ammeters. The two feeder panels each carry one ammeter and one triple pole oil break switch fitted with two maximum over load trip coils and one no-volt trip coil. A swinging bracket fitted on the end of the switchboard carries a rotary type syncroscope, a busbar volt meter, an incoming machine volt meter and a frequency meter. The board also carries a recording watt meter of the unbalanced load type.

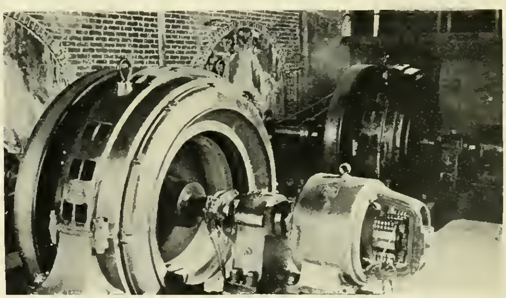
On account of the comparatively short distance between the pulp mill and the power house, it was not advisable to step up the voltage and energy is therefore transmitted at the generated voltage of 600. On this account very large cables are used. These are of aluminium, 960,000 circular mils in cross section. There is a double 3-phase circuit carried on a two-pole line. At certain points where terminal towers are required, these are of the four-pole type. Poles are spaced approximately 90 feet apart.

The sub-station equipment consists of a distributing board of enamel slate fitted with 800 ampere, 3-pole, slow break knife switches for controlling the lines from the power house. From this switchboard four circuits are distributed, each fitted with one ammeter and a 3-pole slow break knife switch. Choke coils and lightning arresters are also supplied at this point for each of the six lines.

The distributing cables run on porcelain insulators, a distributing box being provided at every junction, these containing switch fuses, one set for each motor. These fuses set very high, being chiefly intended for protection against line troubles, each motor starter being provided with no-volt overload features to care for ordinary overloads.

The motors used to operate the various equipment throughout the mill vary in size from 7 to 250 h.p., 31 motors in all being installed. The various motors with the uses to which they are put are as follows:

One 7 h.p. for conveyor; four 7 h.p. for pumps; two 8 h.p., conveyors; three 10 h.p., recovery pumps; one 13 h.p., chip conveyor; one 20 h.p. boiler feed pump; five 25 h.p., barkers; one 25 h.p., liquor pumps; one 50 h.p., main water pump; one 50 h.p., induced draft fan; one 50 h.p., pulp wood conveyor; one 75 h.p., line shaft; one 90 h.p., screen room; two 90 h.p., recovery room; one 90 h.p., slasher; one 90 h.p., hog; one 180 h.p., beater room; one 150 h.p., conveyor and pump; one 250 h.p., saw mill.



Two 750 kv.a. generators, with exciters.

Of these motors the two largest are the wound rotor type but all the others are squirrel-cage motors.

The various pumps with their sizes and the uses to

which they are being put are:—one 1,000 gal. unit for pumping caustic liquor; one 1,400 gal. unit for main water pumping operating at a 105 ft. head; three 450 gal. 33 foot head, caustic liquor pumps; four 375 gal. 25 foot head, pumps specially installed for operating the digesters under 125 lbs. pressure, and one 1,000 gal. boiler feed pump working under a 370 foot head. All the above pumps are centrifugal type and direct-connected to the motors. The main water and boiler feed units are medium and high lift turbine types respectively.

The dam, pipe line and power house were planned and constructed under the supervision of the engineering firm of Harris & Harris, Confederation Life Building, Toronto. Mr.

Design of two-pole tower.

A. L. Cavanagh was resident engineer on the work. The turbines were manufactured by Jas. Gordon & Company, of London, Eng.; the stop-log and gate winches were supplied by the Wm. Hamilton Company, Peterboro. The structural steel racks, etc., were furnished by the Jenckes Machine Company, Sherbrooke; steel pipe bands, by the Steel Company of Canada; governors are of the Lombard type; generators were manufactured by the Lancashire Dynamo & Motor Company, Manchester, as were also the motors. The switchboard is of Ferranti manufacture. The pumps were supplied by W. H. Allan, Son & Company. The supply and installation of the turbines, governors, generators, motors, pumps, switchboards and transmission line were in charge of the engineering contracting firm of Chapman & Walker, Toronto.

Personal

Mr. Chas. F. Barnes has been appointed acting manager of the London Electric Company, succeeding Mr. E. I. Jenking.

Mr. Warren Y. Soper, vice-president of the Ottawa Light Heat & Power Company, is enjoying a motor trip through Maine this month.

Mr. Thomas Ahearn, President of the Ottawa Electric Railway Company, and Mr. James D. Fraser, secretary-treasurer, returned last week from a two months' motor tour of the United Kingdom. Mr. Ahearn took over his own car and chauffer and the 1,600 mile trip was made without any mishap or accident whatever, nor even a puncture. They also visited the International Exposition in Ghent.

Trade Publications

Steam Traps—Bulletin issued by Canadian Allis-Chalmers, Limited, descriptive of the "Squires" improved steam traps.

Weatherproof Sockets:—Form 629, issued by the H. W. Johns-Manville Company, describing J. M. moulded weatherproof lamp sockets.

Dossert Connectors—The Canadian General Electric Company are distributing a small pamphlet descriptive of Dossert Connectors, for which this company are selling agents.

Electric Flashers—Bulletin No. 27, issued by the Reynolds Electric Flasher Manufacturing Company, descriptive of Reco flashers, comprising single pole, double pole, on and off, two or three color, spelling, speed, script, chaser, lightning, flag and cabinet types.

Electric Grinders—Bulletin E29, issued by the Chicago Pneumatic Tool Company, descriptive of Duntley Electric Grinders of various types. Also bulletin 34B issued by the same company descriptive of pneumatic power driven compressors.

Arc Welding—Catalogue 3002 issued by the industrial and power department of the Westinghouse Electric & Manufacturing Company. This catalogue is more or less historical, describing the various methods of electric arc welding with special reference to the latest and most approved process.

Car Equipment—The Electric Service Supplies Company have just issued their supplement to catalogue No. 4, volume 2, which deals with car equipment and supplies. The supplement is splendidly bound in cloth, and comprises some 170 pages of well printed and illustrated matter with reference to their new and improved devices.

Steel Gear Cases—The Electric Service Supplies Company have recently issued a folder illustrating and describing the different processes of manufacture of their Keystone Steel Gear Cases. Illustrations clearly indicate the method of spot-welding embodied in the manufacture of these cases, as well as their repairability and lightness.

Westinghouse—Leaflet 3572, describing, with ilustrations, the New York, New Haven and Hartford, 11,000 volt, single-phase, alternating current railroad electrification; leaflet 3517, describing Westinghouse portable sub-stations; leaflet 3685, describing direct current, commutating pole, type S. K. generators, 1½ to 200 kw. capacity and 125 to 250 volts.

Charging Rheostats—The Cutler-Hammer Manufacturing Company, Milwaukee, have just published a new edition of Bulletin No. 8540, dated August, 1913, which supersedes their former bulletin of the same number, but of an earlier date. The new bulletin contains prices and data on their various types of charging rheostats for both lead and Edison batteries, including wall, floor and switchboard types, besides two styles of automatic rheostats.

Sand Drier—"The Electric Service Supplies Company have issued a folder describing, illustrating and listing their new improved Keystone Sand Drier. The new features embodied in this sand drier overcome many of the difficulties railway, mining and construction companies have met with in solving the problems of drying sand.

Copper vs. Aluminium Cables in Mines

Insulated and Bare Copper and Aluminium Cables for the Transmission of Electrical Energy, with Special Reference to Mining Work

By Burkewood Welbourn, M. Inst. E. E.[*]

While copper is a well understood and consistently reliable metal, and standard cables, fittings, etc., have been worked out for it, and the disposition undoubtedly is to leave well alone, there is no inherent electrical reason why insulated aluminium conductors should not be used for all purposes and at all working pressures. The writer believes that there will be little disagreement with his own conclusion as regards the use of copper or aluminium, namely, that every case should be settled on its merits. Usually, this will resolve itself into a question of a strict comparison of the cost of the rival systems. The matter is worth close investigation as the transmission of the current may account for 50 per cent. of the cost of the electrical equipment of a mine.

The world's annual production of copper is about 1,004,485 tons, and of aluminium approximately 60,000 tons. There is some uncertainty as to the figures of production for the United States, as they are kept secret. From the foregoing statistics, however, it may be deduced that aluminium has not, up till now, made any serious impression on the use of copper for electrical work. It is thought that only about 15 per cent., or say 10,000 tons, of all the aluminium produced is so used, and it will be seen later that this is only equivalent to 20,000 tons of copper. It is known that further plants are now being constructed which will increase by 50 per cent. the present output of aluminium within the next two or three years; and, as improvements in manufacturing methods are likely to reduce the cost of production, a reduction in the selling price should follow, and result in a considerable increase in its use for electrical work, unless a corresponding reduction is made in the price of copper.

Properties of Copper and Aluminium Compared

(a) **Chemical.**—Electrolytic copper-wire bars contain about 0.2 per cent. of impurities, and should comply with the requirements of the Engineering Standards Committee of March, 1910; but there is no E.S. Committee's standard for aluminium. Aluminium bars usually contain 0.5 to 0.7 per cent. of impurities (chiefly silicon and iron), and these should never exceed 0.71 per cent., at which figure the conductivity of hard-drawn aluminium is 60 per cent. when compared with the British standard for hard-drawn copper at 60 deg. Fahr.; with 0.5 per cent. of impurities the conductivity will be as high as 61.7 per cent. If the impurities do not exceed 0.75 per cent., as can invariably be arranged, then the writer is of opinion that bare aluminium wires can be used in the United Kingdom in any situation in which copper wires can be employed. This opinion has been arrived at after careful inquiry in various quarters, and after tests made by Dr. T. T. Best and the writer at Hardshaw Brook Chemical Works, St. Helens, Lancashire.

It has frequently been stated that aluminium is quite unsuitable for use on overhead lines on the coast, because of the salt spray. This, no doubt, is true if aluminium alloy is used; but if aluminium of the purity previously mentioned is employed, no more corrosion will take place than with copper, as is shown by the present condition of the aluminium cable, which has been in use on an overhead line at Larne Harbour, County Antrim, for about 10 years. Aluminium will not withstand hydrochloric acid or alkaline solutions, but it is extremely unlikely that such chemicals would be found in any situation in which an overhead line (copper or aluminium) should be used. For lines near coke-ovens, aluminium should always be used, as it resists the action of sulphur dioxide products, whereas copper will no do so. It is well known that when copper cables are insulated with vulcanized bitumen or rubber, the outside layer of the wires must be tinned to prevent the action on the wires of the sulphur employed in the vulcanizing process. When aluminium is substituted for copper, no such precaution is needed, as it is not acted on by sulphur.

(b) **Electrical.**—In Table I. the electrical conductivity of copper and aluminium is compared:—

Table I.—Comparison of Electrical Conductivity of Copper and Aluminium

	Copper	Aluminium
Conductivity for equal section	1.00	0.60
Section for equal conductivity	1.00	1.666
Diameter for equal conductivity	1.00	1.29
Weight for equal conductivity	2.00	1.00
Weight for equal bulk	3.30	1.00

If equal sections of copper and aluminium are tested under equal conditions, it will be found that an aluminium conductor will carry 60 per cent. of the current that a copper conductor will carry with the same loss of energy. Conversely, the cross-section of an aluminium conductor must be 1.666 times that of a copper conductor if it is to carry the same current with equal drop of pressure. To make this clear, the following example will be taken:—

A copper conductor of 0.10 square inch area will carry 100 amperes, when worked at the standard density of 1,000 amperes per square inch. An aluminium conductor of 0.10 square inch area will only carry 60 amperes. From this it follows that an aluminium conductor for 100 amperes must have a cross-sectional area of 0.1666 square inch. By an extension of the previous example, it will be found that, for a given current, the aluminium conductor required has a diameter which is 29 per cent. greater than the copper conductor. Because of that larger diameter, insulated aluminium cables have an electrostatic capacity about 14 per cent. greater than that of the equivalent copper cables, and this may prove advantageous where alternating current systems are working at a low power factor. A noticeable feature in the comparison is that, for a given current-carrying capacity, theoretically only half the weight of aluminium is required as compared with copper, and in practice this is also nearly true. This lightness is of considerable importance, especially when bare conductors have to be transported across country for overhead-line construction.

(c) **Physical.**—The co-efficient of linear expansion per degree Fahrenheit is 40 per cent. greater for aluminium than for copper. So far as the author is aware, this has not been a source of difficulty, but it is evident that provision should be made for the expansion of insulated aluminium conductors, if they are to be worked up to their full current-carrying capacity, as, with insulated cables, heat is not rapidly dissipated. With uncovered aluminium cables, however, the dissipation of heat is more rapid than with copper cables, as on account of their greater diameter the radiating surface is greater. The difference is sometimes as much as 10 per cent.

(d) **Mechanical.**—Annealed metals are employed for the conductors of insulated cables, and are not used under ten-

[*] Extracted from paper read before the I.M.E.

sile stress, so that their tensile strength is of no importance; the strength is, however, all important for overhead lines, and hard-drawn conductors must always be used for them. The strength of hard-drawn copper and aluminium varies widely, and depends on whether the material is hot-rolled or cold-rolled. Hot-rolled copper gives sufficiently good results for all purposes which are being considered, but aluminium for overhead lines should always be cold-rolled, despite the greater expense. Cold rolling, coupled with improved manufacturing processes in England, has increased the breaking-strain of aluminium by 10 per cent. over that obtained only three years ago. As this result has considerable bearing on the design of overhead lines, it is suggested that individual wires for such lines should be specified to comply, after stranding, with the tests given in Table II.; without interfering with the electrical conductivity already mentioned:—

Table II

Standard Wire Gauge.	Diameter of Wire	Breaking strain.	Extension on a 5-inch Length.	Wrapping Test.
	Inches.	Tons per square inch	Per cent	
4	0·232	11·00	3·00	Three times round its own diameter on and three times off.
6	0·192	12·00	3·00	
8	0·160	13·00	3·00	
10	0·128	13·50	3·00	
12	0·104	14·00	2·50	
14	0·080	14·50	2·50	
16	0·064	14·75	2·50	

The object of the wrapping tests is to ensure that no brittle wire is used.

It will be noticed that no suggestion is made in Table II. as to what the limit of elasticity (yield-point) should be. For aluminium it is usually assumed to be 70 per cent. of the ultimate breaking-strain, and, for copper, 75 per cent. In the case of aluminium, the yield-point is not readily ascertained by an inspection of a stress-strain curve, but Messrs. Burstall and Monkhouse, from the results of their investigations, take the yield-point at the stress where the permanent set is a hundredth of an inch on a 5-inch test-piece.

The breaking stress was 12.45 tons per square inch; the yield-point 9.54 tons per square inch, equal to 76.5 per cent. of the breaking-stress; and the extension on the 5-inch test-piece was 3 per cent.

It should not be inferred that the limit of improvement in manufacture has been reached, as recent independent tests on single wires from a 19/0.183 stranded conductor gave the following results:—

Breaking-strain ... ... .15.38 tons per square inch.
Yield-point ... ...10.07 tons per square inch.
Extension ... ...3 per cent.

On a large number of wires of a diameter of 0.201, 0.142, and 0.135 inch respectively, the average breaking-load was 14 tons per square inch, the limit of elasticity 10 tons per square inch, and the extension 4½ per cent. after stranding.

The Transmission of Electrical Energy

For transmitting electrical energy for mines, both copper and aluminium may be employed.

(a) As insulated conductors in the form of cable for use below ground.

(b) As bare or braided conductors suspended on insulators on an overhead line on the surface.

It will be convenient to discuss (a) under the general heading of "Insulated Cables," and (b) under "Overhead Lines."

(a) **Insulated Cables.**—Up to the present time copper conductors for insulated cables have had almost a monopoly in this country, both for high and low-pressure work, and there appears to be no case in the United Kingdom in which aluminium cables have been used for shaft or in bye work in a mine. In mines, except for electric lighting distribution circuits, cables are almost invariably insulated with impregnated paper, or bitumen, and they are usually protected with wire armour and compounded tapes or jute. The armour is used for,

(1) Mechanical protection and for relieving the strain on a cable when suspended or when a "fall" occurs.

(2) Providing an earthed conductor to surround the cable for the prevention of shock in the event of a fault, by carrying any leakage current directly back to the controlling switchboard, and ensuring the immediate cutting off of supply from the faulty cable or apparatus.

(3) Assisting in preventing open sparking. In the case of paper-insulated cables, a lead sheath is frequently employed below the armour to keep the paper dry, and it, also, materially assists in the prevention of open sparking, and is therefore to be preferred to a bitumen sheath.

Some stress is laid on the use of armour, because the diameter of aluminium cables is greater than that of the equivalent copper cables, hence the cost of protecting an aluminium cable exceeds that of a copper cable. Compounded tapes or jute string are used to protect the armour, etc., from corrosion, and should be impregnated in vacuo with a flexible waterproof compound before application to the cable. Investigation of cables protected with jute string shows that the jute opens at bends in the cable and allows the water of the mine, often corrosive, to have access to the armour. The writer is of opinion that compounded hessian tapes afford much more certain protection than jute string. Too much stress need not be laid on the corrosive action of water, provided that the best modern armoured and taped cables are employed; but, undoubtedly, fair samples of the mine waters should always be analysed by an experienced chemist before a final decision is taken as to the cable to be installed. The chief corrosive agents to be guarded against in vulcanized-bitumen cables are (1) caustic soda, due to the electrolysis of salt on the occurrence of a leakage of direct current; (2) lime in concrete and mortar; and (3) alkaline waters, due to calcium carbonate.

With regard to lead-sheathed cables, there are very few corrosive agents which will attack lead. Those which do so form a protective coating on the lead, if not subjected to external electrolysis. There have been a few cases of corrosion of lead sheathing in mines, but expert examination always reveals (1) that the corrosion is the result of chemical action aided by electrolysis, and not of chemical action alone; (2) that corrosion is almost confined to direct-current circuits only; or (3) that the lead has not been made continuous and connected to earth. In two-phase and three-phase work, the writer has never known a case of electrolytically corroded lead, and if such corrosion occurs at all, it must be very rare. It can be said, with entire confidence, that corrosion of the lead sheathing due to electrolysis cannot occur on alternating or direct current circuits if the Home Office requirements for the continuity and earthing of the lead and armour on cables are adhered to.

The writer has no desire, on the present occasion, to reopen the controversy between the advocates of paper and bitumen insulation. He would only plead for the very highest standard of cable work in mines, whether copper or aluminium conductors are used, and indicate his personal preference for paper-insulated lead-sheathed cables. It may be taken as a general rule that such cables amply repay all the care in manufacture and installation that may be lavished on them. They will then form the most reliable part of the electrical installation, just as they have proved to be in traction, power, and lighting undertakings.

(i) **Cables with Copper Conductors.**—These are so well understood that it is difficult to say anything new about

them, but it is thought that the following information will be helpful to mining engineers.

It is sometimes noticeable in technical papers that all reference to cost is omitted. This seems, in many instances, to be an error of judgment, as it is desirable that every practical aspect of any problem should be given. Bearing this in mind, several tables have been drawn up here which, it is hoped, may prove useful in deciding what type of cable shall be installed in any given case. The first table (III.) compares directly the relative prices of low or medium-pressure three-core copper conductor shaft-cables (a) paper-insulated lead-covered double-wire armoured, taped, and compounded; and (b) vulcanized-bitumen insulated double wire armoured, taped, and compounded:—

Table III.—Comparison of Prices of Three-core Medium-Pressure Paper and Bitumen-insulated Shaft-Cables

Area Square Inch	(a) Paper-insulated	(b) Bitumen-insulated
0.05	1.00	1.19
0.10	1.00	1.15
0.25	1.00	1.13

Table IV. gives the relative prices for various low or medium-pressure three-core cables with copper conductors for in-bye use.

Table IV

Description	Sectional Area, in Square Inches 0.05	0.10	0.20
(a) Paper insulated with sector cores, lead-sheathed and single-wire armoured	1·00	1·00	1·00
*(b) Paper insulated with sector cores, vulcanized-bitumen sheathed and single-wire armoured	1·10	1·09	1·06
(c) Vulcanized bitumen, insulated, with round cores and single-wire armoured	1·18	1·15	1·12
*(d) Paper insulated with sector cores, vulcanized-bitumen sheathed and double-wire armoured "leadless" cables	1·40	1·31	1·22
*(e) Vulcanized-bitumen, insulated, with round cores and double-wire armoured	1·48	1·38	1·29

* These cables could also be used for shaft-work

(ii) **Cables with Aluminium Conductors.**—Seeing that aluminium cables have not been used in mines in this country, it is necessary to examine the evidence for them critically. Apart from several short lengths of aluminium cables, the most important cases in which they have been used in this country are as follows, and it is within the author's knowledge that they work quite satisfactorily:—

(1) The Manchester Corporation Electricity Department has over 11,000 yards of single-core paper-insulated lead-sheathed cable in use, chiefly of 1.66 square inch area, at varying pressures up to 600 volts as direct-current traction and lighting feeders. Some of the cable has been in use for nearly four years.

(2) The Bolton Corporation Electricity Department has had 1,440 yards of single-core 1.66 square inch paper-insulated lead-sheathed cable in use as low and medium-pressure direct-current feeders for over three years.

(3) The Metropolitan Electric Supply Company, Limited, London, has in use about 6,000 yards of 0.83 square inch medium-pressure concentric and triple concentric paper-insulated lead-sheathed cable.

Other users of aluminium cables include the County of London Electric Supply Company, Limited, Ealing Corporation, and the Stanton Iron Works Company, Limited.

In Europe, chiefly in France, Germany and Switzerland, extensive use has been made of these cables in the streets. The writer has seen a list of places in which over 800 miles of cable are employed at voltages varying from 240 to 60,000 (single-phase). The City of Zurich alone has 238 miles, while the Paris General Omnibus Company has in use armoured single-core tramway feeder-cables involving the use of 300 tons of aluminium, and has on order cables amounting to a further 300 tons. There seems to be, therefore, sufficient evidence already in existence to justify the use of aluminium cables where there is a saving in cost.

(iii) **Comparison of Prices of Insulated Copper and Aluminium Cables.**—At the time of writing this paper (March, 1913) the market values prevailing have been used in working out the comparative prices of insulated cables as follows:—

	£	s.	d.
Copper (electrolytic wire bars), per ton of 2,240 lbs.	69	5	0
Aluminium " " " "	90	10	0

The price of copper stated above is about 5 per cent. higher than the average price for the last 15 years, during which period it has fluctuated between £54 and £122 per ton. On the other hand, aluminium has fallen from about £200 per ton to the above figure, after making a somewhat artificial drop to £60.

In order to make an effective comparison between the prices of insulated cables with copper and of those with aluminium conductors, it will be convenient to consider fully some types and sizes of cables which are commonly employed in three-phase and continuous-current work.

For three-phase work at low and medium pressures a 0.10 square inch three-core paper-insulated lead-sheathed cable with copper conductors has been selected. The equivalent aluminium cable will, as has been seen, have a sectional area of 0.166 square inch. In Table V. those under division 2 are suitable for in-bye use; while those under division 3 are for shaft or in-bye use.

Table V

Description.	(1) Plain lead-sheathed. 0·10 square inch three-core Copper	Equivalent Aluminium	(2) Single-wire armoured. 0·10 square inch three-core Copper	Equivalent Aluminium.	(3) Double-wire armoured. 0·10 square inch three-core Copper.	Equivalent Aluminium
When aluminium wire bars are £22 per ton above the price of copper wire bars	1·00	1·00	1·00	1·035	1·00	1·055
When aluminium bars are £10 per ton above copper bars ...	1·00	0·96	1·00	1·00	1·00	1·03
When aluminium and copper bars are the same price per ton ...	1·00	0·93	1·00	0·98	1·00	1·00
When aluminium bars are £10 per ton below copper bars ..	1·00	0·90	1·00	0·95	1·00	0·98

From the foregoing table it will be seen that the aluminium cable is the cheaper:—

(a) In plain lead-sheathed cables whenever aluminium wire bars are less than £22 per ton above the price of copper bars.

(b) In single-wire armoured cables whenever aluminium wire bars are less than £10 per ton above the price of copper bars.

(c) In double-wire armoured cable whenever aluminium wire bars are lower in price than copper bars.

For continuous-current work, at low and medium pressures, a similar comparison will be found in Table VI. between a 0.30 square inch copper single conductor paper-insulated lead-sheathed cable and the equivalent 0.50 square inch aluminium cable.

Table VII. is similar to Table VI., and gives a comparison of the same conductors but bitumen-insulated, etc.

Table VI

Description.	(1) Plain lead sheathed		(2) Single-wire armoured		(3) Double-wire armoured	
	0 30 square inch Copper	0 50 square inch Aluminium	0 30 square inch Copper	0 50 square inch Aluminium.	0 30 square inch Copper	0 50 square inch Aluminium.
(*a*) When aluminium wire bars are £42 per ton above the price of copper wire bars	1 00	1·00	1 00	1·043	1 00	1·07
(*b*) When aluminium bars are £22 per ton above copper bars ...	1·00	0·92	1·00	0 983	1·00	1·015
(*c*) When aluminium bars are £10 per ton above copper bars	1·00	0·89	1·00	0·955	1·00	0·99
(*d*) When aluminium and copper bars are the same price per ton	1·00	0·855	1·00	0·930	1·00	0·97
(*e*) When aluminium bars are £10 per ton below copper bars ...	1·00	0 825	1 00	0 903	1·00	0·945

Table VII

Description.	(1) Braided only		(2) Single-wire armoured		(3) Double-wire armoured	
	0 30 square inch Copper	0 50 square inch Aluminium.	0 30 square inch Copper	0 50 square inch Aluminium	0 30 square inch Copper	0 50 square inch Aluminium
(*a*) When aluminium wire bars are £42 per ton above the price of copper wire bars ..	1·00	1·00	1·00	1·033	1·00	1·05
(*b*) When aluminium bars are £22 per ton above copper bars ..	1·00	0·93	1·00	0·98	1·00	1·005
(*c*) When aluminium bars are £10 per ton above copper bars .	1·00	0·90	1·00	0·955	1·00	0·985
(*d*) When aluminium and copper bars are the same price per ton	1·00	0·865	1 00	0·93	1·00	0·965
(*e*) When aluminium bars are £10 per ton below copper bars	1·00	0·835	1·00	0·91	1·00	0·945

Attention should be particularly directed to the comparative figures for unarmoured cables in division 1 of Tables V., VI., and VII., because there are installations where economies can be effected by using such aluminium cables on the surface works only, especially when the generating station or sub-station is situated at any considerable distance from the shaft. It should be stated briefly, also, that with larger sizes of unarmoured continuous-current cables, the saving is greater than is shown in Tables VI. and VII., and that unarmoured concentric and triple concentric aluminium cables for pressures up to 650 volts usually show a considerable saving over the equivalent copper cables. One such case came under notice this year, where a triple concentric aluminium cable showed a saving of 20 per cent. over the corresponding copper cable.

For 3,000-volt three-phase cables a similar close investigation has not been made, but it is instructive to examine the case of a 0.20 square inch paper-insulated three-

Table VIII

	(a) 0·20 square inch Copper.	(b) 0 333 square inch Aluminium.
(1) Price ..	1·00 (unity).	1·11
(2) Net weight of length ..	144 cwts.	161 cwts
(3) Size of drum .	7 feet 8 inches in diameter by 3 feet 10 inches in width.	8 feet 2 inches in diameter by 3 feet 10 inches in width.
(4) Overall diameter	2·70 inches.	3·07 inches.
(5) Capacity in microfarads per mile at 60° Fahr.; 1 core to others and the sheath	0·70	0·80

core 3,000-volt copper conductor lead-sheathed and double wire armoured cable 470 yards long which was supplied to a colliery company, and to compare it with the equivalent aluminium cable. Table VIII. sets out the comparative prices and details of this cable and of the corresponding aluminium cable as at March, 1913.

This table clearly shows that the aluminium cable cannot compete in this case either in price or in weight. In the above example, if plain lead-sheathed cables had been permissable, the aluminium cable would have cost 4 per cent. more than the copper cable. It is instructive also to compare the prices of cables exactly similar to the foregoing, but with 0.10 square inch copper and 0.167 sq. in. aluminium conductors with the plain lead sheath, the aluminium cable would cost 4 per cent. less than the copper cable, but with double-wire armouring, the cost would be 2 per cent. more. These figures and the weights of the cables are set out in Table IX.

Table IX

Sectional Area.	0 10 square inch Copper		0 167 square in Aluminium		0·20 square inch Copper		0·333 square inch Aluminium.	
Class	"A"*	"DDB"†	"A"*	"DDB"†	"A"	"DDB"†	"A"*	"DDB"†
Price	1·00	1 00	0·96	1·02	1 00	1·00	1·04	1·11
Approximate net weight per 470 yards, in cwts.	51	95	55	111	81	144	86	161

* Plain lead-sheathed cable.

† Double-wire armoured and tape-protected cable.

Frequently it is decided in three-phase mining work to "earth" the neutral point of the system and so reduce the working pressure between the conductors and the earth. This enables changes to be made in the design of cables which work at 2,000 volts and higher pressures, with consequent saving in first cost. At 2,000 and 3,000 volts, three-core cables built for "star" working are cheaper than cables for "delta" working by about 0.5 per cent. on small cables of 0.025 square inch, and by about 1.5 per cent. on cables of 0.30 square inch. At 6,600 volts, the corresponding savings would be 3.00 per cent. and 10.00 approximately.

(iv) **Comparison of Weights of Insulated Copper and Aluminium Cables.**—Supplementing the information already given for 3,000-volt cables, Table X. gives some comparative

Table X

Sectional Area of Cable	Size of Drum.			Copper Conductors.		Aluminium Conductors of Equivalent Section	
	Barrel.	Flange.	Width between Flanges.	Length of Cable on Drum	Approximate gross weight of Cable on Drum	Length of Cable on Drum.	Approximate gross weight of Cable on Drum
Square Inch	Inches	Inches	Inches.	Yards	Cwts	Yards	Cwts
0 025 single	20	42	36	570	25	512	23½
,, twin	24	42	36	227	20	187	19
,, three core	24	42	36	198	20½	170	19
0·050 single	20	42	36	490	25½	438	24
,, twin	27	42	36	141	17¼	114	16¼
,, three core	27	42	36	126	18¾	105	16¾
0·100 single	24	42	36	230	22	265	19¼
,, twin	33	45	36	88	15½	69	14½
,, three core	33	45	36	78	16½	61	14½
0·250 single	27	42	36	190	20¼	166	18¾
,, twin	40	54	36	84	24	65	20½
,, three core	40	54	36	76	25	58	20

data for different types of low and medium-pressure vulcanized-bitumen double-wire armoured cables (both with copper and aluminium conductors) which can be accommodated on a cable-drum not exceeding 4½ feet in diameter and 3 feet between the flanges. This information should be of assistance in planning out work below ground. Similar

figures would hold good for paper-insulated lead-covered double-wire armoured cables, which are usually smaller in diameter than vulcanized-bitumen-insulated cables, although somewhat heavier.

(b) **Overhead Lines.—(i) General.**—As with cables, overhead lines should be constructed with the best available materials and workmanship throughout, and then they will prove to be very reliable in practice. Usually they are considerably cheaper than insulated cables, and the saving that may be effected frequently is as much as 50 per cent.

For overhead lines the copper or aluminium employed must be hard-drawn, and it is customary to use a stranded conductor, because its breaking-strain is greater than for a solid conductor of equal cross-sectional area. It is also usual to employ the smallest practicable number of wires in a strand so that each wire may be made to take its proper share of the longitudinal stress; but it is not advisable to use any aluminium wire exceeding 0.25 inch in diameter; and in conductors up to 0.25 square inch no individual wire should exceed 0.169 inch in diameter. Wherever it is desired to protect either metal from corrosion, etc., servings of single, duplex, or treble weather-proof compounded braid should be provided. In these cases, the extra windage surface of the lines, their increased weight, and possible extra collection of snow, should be allowed for in designing the poles, etc.

There are legitimate differences of opinion as to factors of safety for copper and aluminium wires. The practice varies widely: for example, in North America, where both aluminium and copper overhead lines are extensively used, the maximum stress employed for both copper and aluminium is 250 per cent. greater than is called for in the British Board of Trade regulations. Making allowance for the elasticity of the metals, experience shows that in most parts of the United Kingdom it is sufficient to allow 17 pounds per square foot of wind pressure and a factor of safety of 3½ for copper and 4½ for aluminium.

Experience has shown in North America that there is much less trouble with aluminium than with copper from ice and snow collecting on the conductors; and if in the future it can be demonstrated that aluminium does not collect these as readily as copper does in this country, then modifications in pole design, etc., will follow, with a further saving in cost in favor of aluminium. Aluminium conductors, being very light and of larger diameter than copper, are blown up vertically as well as horizontally in strong gusts of wind, and they require to be amply spaced, which increases the cost. So far as the author knows, copper wires in this country are never blown in any other direction than sideways.

Two frequent arguments against the use of aluminium are (a) that aluminium has an uncertain scrap value; and (b) that there are considerable difficulties in jointing the metal satisfactorily. This latter point has already been fully dealt with. In regard to (a), at one time there was a difficulty in selling scrap aluminium, but now there is none. Clean, commercially pure aluminium scrap, as obtained from cables or from overhead lines, can readily be sold at about £22 per ton below the market price of aluminium-wire bars, whereas the price of clean electrolytic copper scrap is about £6 per ton below the price of wire bars.

The writer is aware of three cases in which aluminium conductors were erected in the United Kingdom during the past ten years, with unsatisfactory results and has been at some pains to investigate them. He is of opinion that these failures were solely due to (a) inferior metal and insufficient knowledge of working it at the time; these causes no longer exist, and (b) inexperience in erection; there is now, however, sufficient experience to draw upon, so that there need be no fear of difficulties from this cause.

Summary

(1) Up to the present, aluminium has not made any serious impression on the use of copper for electrical work in the United Kingdom, but it is coming increasingly into favor.

(2) The initial difficulties in regard to the purity of aluminium, methods of working it, etc., have been overcome, and it can be safely used, as a conductor on an equal footing with copper.

(3) For mining work in the United Kingdom, at the present prices of copper and aluminium insulated cables with copper conductors and for all pressures are the cheaper, while, for overhead lines, aluminium conductors are the cheaper.

(4) Paper-insulated lead-sheathed cables are cheaper than bitumen-insulated cables, whether the conductors be of copper or of aluminium.

(5) Both copper and aluminium conductors can be efficiently jointed by well-proved methods.

Held Convention in Vancouver

The fifth annual convention of the Pacific Claim Agents Association was held in Vancouver, B.C., July 10-12. The organization includes among its membership practically all of the electric and steam railways on the Pacific coast. This was the first time the convention has been held in Canada, and although the location of the convention city at the extreme north of the territory covered was such as possibly prevented a full attendance, about 25 claim agents were present, the representation covering the coast cities from Los Angeles, north, and from Spokane, west. Among the visitors to the convention were Mr. E. Daggett, chief commissioner of the State Commission at Washington, dealing with matters connected with the state workmen's Compensation Act, who gave a very full explanation of the manner in which this act was working out both to the advantage of employer and employee. Papers read at the convention covered all phases of the work of the claim agent's office, including such subjects as "The Value of Safety Committees and the best type of organization;" "The value of index bureaus in connection with fradulent claims;" "Unreported accidents;" "Workmen's compensation and industrial insurance," etc.

The sessions of the convention were held in the general hall of the B. C. Electric Social Club, the convention being welcomed to the city by Mayor Baxter and Mr. F. R. Glover of the B. C. Electric, the latter taking the place of general manager Sperling, who was detained from attendance on account of business engagements. A number of the delegates were accompanied by their wives and families, the entire party numbering about fifty. The B. C. Electric provided entertainment for the party from the moment of its arrival until the close of the convention, every hour of the day and evening being filled with auto rides, interurban tram trips or launch rides to various points of interest about the city.

The Largest Gas Engine

The Ford Automobile Company are installing what is probably the largest gas engine in the world, at their works in Detroit. There are four double acting cylinders 42-in. x 72-in., two in tandem upon each side, held together with four 6-in. tie-bolts. The engine is designed to run at 85 r.p.m. or 1020 ft. of piston speed. The length of the engine from the front of the pillow block to the end of the tail-rod extension is 73 feet and its over all width is 32 feet. The crankshaft is 32 inches in diameter and 25 feet long and carries an 80-ton fly wheel and the armature of a 2,500 kw. generator. The generator is capable of carrying a 25 per cent. overload and the engine is rated at 5,000 h.p.

Electric Railways

Description of Five 50-Ton 600-1200 Volt Electric Locomotives for Freight Service on the B. C. Electric Railway, Vancouver

Five 50-ton electric locomotives have recently been built for the British Columbia Electric Railway Company, Vancouver, B.C. These locomotives are intended for freight service, and are similar to a number of 60-ton locomotives recently constructed for the Southern Pacific Company. They are standard gauge, and are of the double truck type with a central cab of the steeple type. This type of locomotive, because of its flexibility and simplicity of construction, is reported to be proving very successful in freight, switching and industrial service where severe operating conditions are frequently met.

Each locomotive is equipped with four Westinghouse No. 308-D-3 box-frame commutating-pole 600-1200 volt railway motors, and Westinghouse type HB unit switch control. These motors are adapted to subway, elevated and trunk-line railroad service. Since they are high powered and of the commutating-pole type, heavy loads can be handled without encountering motor troubles that are incident to such conditions. They are also well adapted where 1200-volt direct current operation is desired, and for such service, two motors are permanently connected in series. The box-frame construction is claimed to offer decided advantages on account of its solid mechanical construction, effective protection, and the alignment of all parts and the commutating-pole feature makes it operate reliably and economically, for heavy overloads can be handled safely, and also a large range of over-voltage incident to the heavy service in which this equipment operates is permissable without serious consequences. Some of the special advantages claimed for this motor by the manufacturers are given below:—

Electrical.—(a) Sparkless commutation under all loads and voltages encountered in normal service; flashing trouble, brush and commutator wear are practically negligible. (b) Thoroughly insulated and easily accessible brush-holders are used. (c) Brush-holders cannot get out of alignment; easily assembled; (d) The brush-holders are provided with an adjustable spring tension which provides uniform brush pressure throughout the life of the brush. (e) Flat braided shunts of ample carrying capacity relieve the brush-holder springs of current, resulting in reduction in heating of brush-holder parts. (f) Effective protection and insulation of armature coils is provided. (g) Bolted commutator construction insures freedom from loose commutator of high bars. (h) Strap-wound field coils are used, which are held under 400 pounds pressure, by springs; the field coils are asbestos insulated between turns; no chafing, vibration or breakdown takes place in this construction.

Mechanical.—(a) Lubrication of oil and waste, separate gauging oil reservoirs; only filtered oil reaches the bearings. (b) Spider armature construction. (c) No broken or bent shafts. (d) Shafts easily removable. (e) Superior gear case suspension. (f) Box frame gives solid mechanical construction. (g) Extensions of the frame project over the axle largely carrying the weight of the motor; axle cap belts are relieved of pounding.

The mechanical features of this motor are of interest. The frame is a one-piece steel casting with large openings bored out at each end to admit the armature bearing housings and for taking out the armature. The weight on the axle is carried almost entirely by a solid bracket which extends over the axle. The split of the axle caps is such that the weight of the motor is taken off the axle cap bolts, thus greatly reducing troubles at this point. The frame has a large lug or nose case on it, which by means of a truck suspension bar carries the weight of the motor except that part carried by the axles. Safety suspension lugs provided as an additional safeguard are so arranged that should the main suspension lug break the motor would drop but a fraction of an inch onto the truck suspension bar causing no trouble.

Axle bearing dust guards are provided consisting of sheet steel casings arranged between the axle bearing housings. The dust guards effectively protect the axle bearings against the entrance of dust and dirt and thereby increase the life of the bearings, gears and axles.

The bearing construction insures good lubrication at all times. Bearings of this design have established a life of 150,000 miles with oiling only once a month. At each inspection it is possible to gauge the oil by means of a chamber provided for this purpose which results in economy in oil. Each housing consists of three chambers, an oil reservoir, a waste pocket, and an overflow pocket. Oil is poured into the oil reservoirs which then, through a bottom connection, reaches the waste in the waste pocket. The oil then filters up to the bearing by capillary attraction, leaving all dirt at the bottom under the waste. The reservoir has ample capacity and is so located in the bearing housings as to be easily emptied and cleaned.

The unit switch control used is similar to that used extensively by many electric railways and electrified steam roads. This control is especially adapted to locomotive services where currents of high value are to be handled and broken, for, due to the inherent construction of the unit switch, there is positive action in the making and breaking of circuits carrying heavy currents, and, due to the high pressure between contacts made possible by closing all switches by compressed air, no overheating or burning is experienced.

The control equipment consists of the following apparatus: 2 master controllers; 2 switch groups; 2 reversers; 1 series parallel switch; 1 line switch; 1 control resister; 2 hand operated change-over switches; 2 sets of storage batteries (10 cells, each set giving 20 volts). All these are enclosed in a wire cage supported by an angle iron frame work in the centre of the locomotive cab.

Grid resistors are mounted in the roof of the locomotive cab over the unit switch apparatus in a portion framed off and ventilated through the roof by two ventilators. Each of the two master controllers have three running matches on 600 volts and two on 1200 volts.

An interesting item of this equipment is a series-parallel switch. The switch is controlled by a single-pole double

throw knife switch at either end of the cab. On 1200 volts the connections are so arranged on the change-over switch that the series-parallel switch is in the 1200 volt position connecting two motors in series regardless of the position of the knife switch. On 600 volts, the connections on the change-over switch are so altered on changing over to the 600-volt position that the motors of each pair by means of the series-parallel switch may be thrown either two in series or two in parallel, where in the 1200-volt position the motors are two in series only. This is of particular advantage on 600 volts in accelerating heavy loads. The motors are first connected four in series until the train is started. The controller is then returned to the "off" position, and the series

Electric freight service on the B. C. E. R. system.

parallel switch thrown to connect the motors of each pair in parallel. The master controller is then operated to connect in "series parallel" and finally in "parallel."

In changing over from 1200 volts to 600 volts, the resistances are paralleled, and also the dynamotor circuits are adjusted for 600 volts. This is all done by the two change-over switches.

On these locomotives particular care has been taken in arranging the apparatus to facilitate ease of inspection and maintenance. By control equipment being centrally located it is accessible from all four sides. This is a distinct advantage to operating companies, since ease of inspection assists in reducing the maintenance. This control location of equipment in standard for Baldwin-Westinghouse locomotives, and well illustrates the advantages of the centralization of equipment.

Dynamotor-compressors are used to furnish compressed air for the brakes and controls. A blower fan attached to the dynamotor shaft furnishes the air for ventilating the main motors. One of these is mounted under each end hood. The dynamotor runs continuously but the air compressor does not run all of the time, it being stopped by a governor throwing the friction clutch out between the dynamotor and compressor. The dynamotor compressor supplies 600 volt current for the lights. A steel air duct built into the frame of the dynamotor compressor delivers air for ventilation to points directly over each motor where by means of canvas ducts the air is conducted to the motor. Two dynamotor switches are furnished, one for each dynamotor. Two transfer switches are used for transferring the lighting load from one dynamotor and the cab lights on the other. All wiring is put in conduit. A complete combined straight and automatic air-brake equipment with two compressors, each having a displacement capacity of 35 cu. ft. of free air per minute, is included in the equipment for each locomotive.

The mechanical parts were built by the Baldwin Locomotive Works. The trucks of the locomotives are of the equalized pedestal type, with rolled steel side frames and angle iron frames. They have rigid centers, the bolsters secured directly to the side frames. The bolsters are of cast steel. The truck is kept square by heavy cast steel gaucet plates, which are bolted to both side frames and bolster. The springs are half-elliptic, and of such length (44 in.) as to insure easy riding qualities. The wheels are steel tired, with cast iron spoke centers.

The frame is composed of four 15-inch longitudinal channels. These are strongly braced transversely, above the truck bolsters, by means of plate stays, which are riveted to the channels, frame bolster and floor plating. The channels are also braced transversely, midway between the truck centers. The end bumpers consist of steel plates 1-in. thick, to which the coupler pockets are bolted. The couplers are of the M.C.B. type, placed at standard height (34½ in.) above the rail.

The cab is of steel, arranged for double end operation. It is provided with end doors, and careful attention has been given to such details as hand-holds, steps and cab windows. A sloping hood is placed at each end of the locomotive. The floor of the cab is of steel plate covered with hard wood matched fibering. The equipment includes air and hand brakes on all wheels, air sanders, a pilot and head light at each end, a bell gong and air whistle.

These locomotives are designed to negotiate curves of 40 feet radius, when running without trailing loads. Their principal dimensions are as follows: wheel-base, rigid, 7 ft. 4 in., total 23 ft.; driving wheels, diameter 36 in.; journals 5 in. x 9 in.; width over all 10 ft.; height of top of car 12 ft.; length between coupler knuckles 35 ft.; weight, 100,000 lbs.

Norfolk & Western Railroad to Electrify

The Norfolk and Western Railroad, which extends from the tidewater at Norfolk, Va., to the coal fields of West Virginia, has contracted with the Westinghouse Electric & Manufacturing Company to supply all the electrical apparatus required to electrify the Bluefield-Vivian section of its line, some 85 miles in length. The carrying out of this contract will give form to one of the most important projects of steam railroad electrification yet undertaken. The contract calls for the manufacture and delivery of twenty-six 130-ton electric locomotives of the single phase, two phase type, together with all required power house generating machinery and transmission apparatus.

Single phase alternating current of a frequency of 25 cycles and at 11,000 volts pressure will be supplied to the locomotives through an overhead suspended trolley wire and will be the identical type of the overhead system that has long been successfully used by the New York, New Haven and Hartford Railroad on its main line, by the Boston and Maine in the Hoosac Tunnel, by the Grand Trunk Railway in the Sarnia Tunnel and by the New York, Westchester and Boston Railway and for which installations the Westinghouse Electric and Manufacturing Company have furnished over 100 locomotives. The Norfolk and Western single phase-two phase locomotives, besides being very large and of enormous hauling capacity, will embody many unique features and requirements of design which, it is expected, will result in their showing unprecedented flexibility and economy of operation.

The Bluefield-Vivian section serves the celebrated Pocahontas coal region, one of the largest coal fields in the world. The tonnage of coal handled amounts to 65,000 tons per day, necessitating trains weighing as high as 3,250 tons, and it is to facilitate the handling of this heavy traffic that the electrical operation has been decided upon. There are a number of grades on this section, the maximum being two per cent., and at the present three Mallet locomotives (the most powerful type of steam locomotives built) are required per train. One locomotive is used at the head of the train and two for pushing. Only two electric loco-

motives will be required for this service and the present speed will be doubled. The extent, therefore, to which this quick train movement will enlarge the capacity of the railroad is quite apparent.

One of the present impediments to rapid operation of this section of the road is the extension of a 3,100 foot tunnel which is difficult to ventilate. This tunnel under electric operation will, of course, owing to the absence of smoke and noxious gases, offer no impediment to frequent train movement.

Since the Norfolk & Western locomotives are intended for handling what is known among railway men as "tonnage trains" they will be built for running speeds of approximately seven, fourteen and twenty-six miles per hour. The design of the electric equipment will be such that the tonnage can be readily increased in the future as the service demands. Power for the entire electrified section will be generated in a central power house located at Bluestone, West Virginia, with an installed capacity of 27,000 kilowatts in turbo-generators, supplied by the Westinghouse Company.

The traffic conditions of this section of the road are especially well adapted to electrical operation. It is in reality a separate engine division at present, and can be operated electrically without affecting the cost of engine service on other sections of the line. Conditions that are conducive to high economy in an electrification like that of the Norfolk & Western are:

1. Traffic requirements such that a minimum electrical equipment will give practically continuous service.

2. Fewer engine crews per train.

3. The speed of operation over the division will be nearly double that possible with present steam equipment.

4. Increased capacity of electrified section.

5. Electric locomotives are not limited to the short hours of service on account of boiler and fire conditions as in steam locomotives.

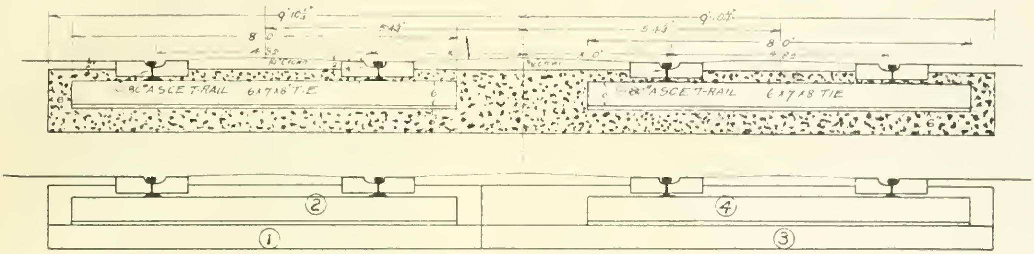
6. Watering and coaling delays incident to steam operation will be entirely eliminated.

7. The general reliability of locomotive operation will be considerably improved.

Work will be begun at once, and the contract calls for its completion in the summer of 1914.

Track Construction in Calgary

The accompanying reproductions show the standard double track construction on paved streets of the city of Calgary's municipal electric railway system. This system now uses an 80-lb. A.S.C.E. rail, though previously they used a 60-lb. and 80-lb. Lorain I.T. rail. It was found, however, that these cost three or four dollars a ton more than the ordinary A.S.C.E. section. The rail block being used this year is a hard silicious sandstone which is set on a dry sand and cement cushion and then grouted. The plan followed is to lay the sub-base below the ties first and, when this is thoroughly set, to lay the track and bring it to line and grade by tamping sand under the ties. When this is completed the balance of the concrete is poured and the rail block set, the asphaltic concrete surface being then laid in the usual manner. A heavy joint is being used this year which goes below the flanges of the rail and is bolted through the web. In the past they have had considerable trouble with joints of the Calgary railway system, but they hope that this year's construction will overcome all difficulties. In previous years the concrete for the sub-base has not been laid separately from the balance of the concrete—but the ties have been supported in position on blocks and the concrete poured right around them. In some cases this has given very satisfactory results, but in others, as already noted, the joints have shown signs of giving way, probably



Standard section of Calgary's municipal street railway double track—Lower figure shows order of placing concrete.

due to the pounding of the cars before the concrete had become very hard. A number double 4/0 bond at each joint with cross bonds about every 250 feet has been used. The intersection work has been supplied by Hatfield of Sheffield, the United States Steel Products Company, and by the Montreal Steel Works. Both the solid manganese steel and the manganese insert construction has been found satisfactory. This year they are having the tongues on the switches supplied with a double groove which promises to be very much more satisfactory than the older type narrow tongue switch, the narrow tongue, even when made in manganese steel, being very liable to get bent. Calgary's city engineer is Mr. Geo. W. Craig, and the superintendent of the street railway system is Mr. Thomas H. McCauley.

Miscellaneous

The temporary bridge over the ravine on St. Clair Ave. for the crossing of the municipal street cars has been approved by the engineers of the Ontario Railway & Municipal Board.

The Board of Control have fixed the fare on the St. Clair avenue lines, soon to be in operation, at 6 for 10 cents. This is the same rate as prevails on the other municipal line now operating, Gerrard street, though the distance will be greater.

A new kind of flooring is being tried out in one of the new cars just put into service by the Ottawa Electric Railway Company. It is called "mastic flooring," and is a preparation something like asphalt, but can resist over 400 degrees of heat before melting. It is put on over the ordinary wood floor in practically the same was as asphalt is put on the streets. The makers, the Canada Floors Limited, of Montreal, claim that their new product has several advantages over ordinary wood floors, namely that it is easier to clean, is more sanitary, better in appearance and almost everlasting. If it proves satisfactory it is likely all the cars owned by the Ottawa Electric Railway will be equipped with it.

Illumination

General Office Illumination

The photograph shown with this article illustrates the remarkable illumination in one of the general offices of Butler Bros., Chicago. The illuminating engineer may soon congratulate himself on the fact that by constantly hammering away at the same spot, he has at last made an impression on the modern office manager. The question of furnishing good illumination in offices now receives, in most cases, the same consideration as the heating, ventilating, air-washing and other requirements for the convenience and comfort of employees. The modern office manager realizes that proper lighting results in greater human efficiency and is thus a paying investment.

The Butler Bros. new building is the largest warehouse in Chicago. It covers one city block and is 15 storeys high. That this firm believe human efficiency is quite as important as machine efficiency is evident from the fact that no pains and expense were spared where the comfort of their many employees was involved. In line with this idea, the question of illuminating such spaces as the offices, salesrooms, restaurant, and merchandise offices, was given careful consideration. It is the obect of this brief paper to describe the results obtained with the indirect illumination which utlimately was decided upon and installed.

Fig. 1 shows a view of the general offices on the main floor. These offices are 150 ft. by 170 ft. an area of 25,500 sq. ft., and the 72 bays are illuminated by means of 288-100 watt indirect units equipped with X-Ray E-200 reflectors. This is a gross allowance of 1.15 watts per square foot. Some idea as to the diffusion of the light and the general uniformity of the resultant illumination may be obtained from this figure. The exposure for the photograph of this installation was made about six o'clock in the evening. The location of this section of the building is such that very little daylight is admitted even on bright days. The exposure was of thirty minutes duration. The ceiling is finished in a light cream with the columns and walls of a slightly dark cream down to about four feet above the floor. The lower wall is finished in a rich deep brown color.

Fig. 1

The type of unit used in this installation is shown in detail in Figs. 2 and 3. The outer brass spinning for supporting the silvered reflector is finished in what is known as "eggshell" white (a mat white washable enamel). The pendant socket and the canopy are finished in a similar manner, and the reinforced lamp cord is also white. The construction of the lower brass spinning is such that for the cleaning of the reflector any of the supporting arms can readily be detached, as shown in Fig. 3. The reflector and lamp need not be removed from the fixture, and as these reflectors can readily be cleaned by merely wiping them with a damp cloth, cleaning labor is reduced to a minimum. In all, some 1,600 units of this same type are installed in the various offices and salesrooms of this building. Again because of the diffusion and uniformity of illumination, the employees are assured of maximum eye-comfort. There is no multiplicity of sharp an-

Fig. 2 Fig. 3

noying shadows, regardless of the position of the person, and there is little glare from glossy paper, desk tops and the like. Increased human efficiency must naturally be the result.

The initial cost of this installation is low. Originally it was planned to provide general illumination with 1 150 watt ceiling unit per bay, and to provide the required local illumination with desk lamps. With the indirect illumination 4-100 watt units are used above, but no desk lamps are required, since the indirect illumination is entirely adequate for the purpose. The cost of energy for operating this installation compares very favorably with any other that might have been installed. The investment and cost of operation of desk lamps has been eliminated. The cost of cleaning is very low, and lamp breakage is at a minimum, since the units may be cleaned without removing the lamp or reflector from the fixture.

Illuminating Engineering Society Convention

At a meeting of the general convention committee of the Illuminating Engineering Society recently held, arrangements were completed for the 7th annual convention of the society which will be held at Hotel Schenley, Pittsburgh, September 22nd to 26th.

The following program of papers has been decided upon:—

Mr. T. H. Amrine, of the Harrison Laboratory of the General Electric Company. Subject, "The Cooling Effect of Leading-in Wires Upon the Filaments of Lamps of the Street Series Type."

M. Georges Clause, of Boulogne, France. Subject:—"The Neon Tube Lamp."

Messrs. E. C. Crittenden and A. H. Taylor, of the Bureau of Standards, Washington, D.C. Subject:—"The Pentane Lamp as a Working Standard."

Mr. G. M. J. MacKay, of the Research Laboratory of the General Electric Company, Schenectady, N.Y. Subject:—"The Use of Nitrogen at Low Pressure in Tungsten Lamps."

Prof. F. K. Richtmyar, of Cornell University, Ithaca, N.Y. Subject:—"The Photo-Electric Cell in Photometry."

Dr. C. E. Ferres, of Bryn Mawr College, Bryn Mawr, Pa. Subject:—"The Efficiency of the Eye Under Different Systems of Illumination. The Effect of Varying the Distribution and Intensity of Light."

Mr. W. A. Darrah, of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. Subject:—"Some Theoretical Considerations of Light Production."

A paper by the Engineering Department of the National Electric Lamp Association, Cleveland, Ohio. Subject:—"Errors in Photometric Measurements."

Dr. C. P. Steinmetz, of the General Electric Company, Schenectady, N.Y. Subject:—"The Development of Alternating Current Luminous Arc Lamps."

Mr. W. A. D. Evans, of the Cooper Hewitt Electric Company, Hoboken, N.J. Subject:—"The Quartz Mercury Vapor Lamp and Its Application."

Mr. V. R. Lansingh, of the Holophane Company, Cleveland, Ohio. Subject:—"Characteristics of Enclosing Glassware."

Mr. S. L. E. Ross, of the General Electric Company, Schenectady, N.Y. Subject:—"The Illuminating Engineering Laboratory of the General Electric Company at Schenectady."

Mr. R. B. Ely, of the Philadelphia Electric Company, Philadelphia, Pa. Subject:—"Church Lighting.

Mr. S. G. Hibben, of the Macbeth-Evans Glass Company, Pittsburgh, Pa. Subject:—"Modern Practice in Street Railway Illumination."

Mr. W. S. Kilmer, of the H. W. Johns-Manville Company. Subject:—"Hospital Lighting."

Mr. H. B. Wheeler, of the National X-Ray Reflector Company, Chicago, Ill. Subject,—"Window Lighting."

Mr. C. L. Law, Supt. of the Bureau of Illumination, New York Edison Company, and Mr. A. L. Powell, of the Harrison Lamp Works of the General Electric Company. Subject:—"Distinctive Store Lighting."

Mr. J. E. Philbrick, of York, Pa. Subject:—"Some Commercial Aspects of Gas Lighting."

Mr. E. F. Kingsbury, of the Photometrical Laboratory of the United States Improvement Company, Philadelphia, Pa. Subject:—"A Problem in Church Lighting."

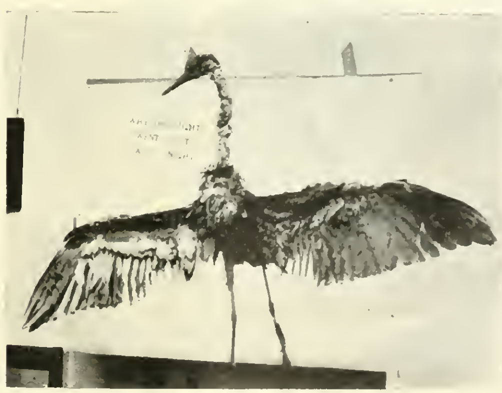
A paper by the Engineering Department of the National Electric Lamp Association, Cleveland, Ohio. Subject.—"New Commercial Fields Opened by Recent Developments in Lamp Manufacture."

Mr. Roscoe E. Scott, of the National Electric Lamp Association, Cleveland, Ohio. Subject:—"The Evolution of Illuminants."

Dr. F. Park Lewis, President of the American Association for the Conservation of Vision, Buffalo, N.Y. Subject:—"The Psychological Values of Light, Shade, Form and Color."

Difficulties in Way of Good Service

The light and power service of the B. C. Electric in Vancouver, B.C., was interrupted recently because of a peculiar condition. A large heron was flying at night over the peninsula between the Fraser river and False Creek and in its course flew into the high tension wires of the company along the line of the Lulu Island railway. A short circuit was made, a foot of each of the three wires at the point being burned out, and the resulting surge temporarily putting the sub-station supplying current for Vancouver out of business. The cause of the short circuit was not known until the following morning when the linemen discovered the



dead heron lying at the side of the track. The B. C. Electric made good use of the dead heron from a publicity point of view. The bird was roughly mounted and displayed in the window of a newspaper office on the principal street of the city with a card hanging from its bill on which was printed, "Why the lights went out last night." This exhibit was visited by thousands during the afternoon and evening, the burnt leg and body of the bird showing at a glance the cause of the interruption to the service and thereby telling without further explanation the difficulties of a light and power company in maintaining an uninterrupted service over a large territory. Cuts of the bird were also shown in the daily papers of Vancouver, accompanied by explanations of the accident.

The Dealer and Contractor

Advertising, with Special Reference to Electrical Contractors

By Mr. P. L. Miles*

The aim of this paper is not to discuss the question. "Is it advisable for the electrical contractor to advertise," but rather to tell how new business may be secured by the use of advertising, properly directed. First of all, it is taken for granted that advertising, properly used, is of great value to the contractor in developing all phases of his business. This point as to the merit of advertising will admit of no argument today. Time after time its value to the wiring game has been demonstrated in various parts of this country. Actual results, in dollars and cents, have entirely settled this one-time question for good and all.

Probably an example is the best manner to illustrate the modern practice in advertising as adopted by the up-to-date electrical contractor. For this purpose, the schemes adopted by a contractor in a middle western town, of some 75,000 population, will be given.

This progressive contractor did a fairly good business in the wiring of houses, both old and new. In addition, he did a small amount of store and building wiring. He wasn't satisfied with his business, however, and looked around for ways and means of increasing his profits.

As a beginning he planned to develop his old house wiring business to the fullest possible extent. He called on the manager of the central station and made them a proposition —If they would furnish him with a list of 1,000 names of people owning unwired houses, these names to consist principally of people living in their own homes, he would circularize this list with advertising matter—more specifically, a series of letters with suitable enclosures. Very little argument was needed to convince the central station manager of the wisdom of supplying this list, as every house that was wired meant additional business for his company.

The contractor prepared a series of letters to be mailed to this list of 1,000 names. In these letters the propects were urged to wire their homes and let him do the work. They were told how many homes, in that particular town, he had wired—the quality of his work, and the reputation he aimed to maintain. With one of the letters a booklet was sent completely describing the operation of the wiring work, and the ease with which it could be done. With another letter a post-card was enclosed, which, when signed, would bring a salesman to give an estimate of the cost of doing the work.

Very soon inquiries began to come in, but there were no orders among them. The prospects wanted to know how much it would cost to do the work, as well as other information. The contractor soon realized that the advertising would not bring actual orders—the best that could be done was to secure inquiries. Yet he was entirely satisfied with these.

Here's what he found from his experience in this campaign:—That the advertising, no matter how carefully prepared, could not tell the prospects all they wanted to know. The information which they desired was—How much will it cost? Would you advise an outlet in the centre or side of a certain room? How about fixtures? How can it be arranged so that I can light my upstairs lights from down stairs? —and similar questions. All of these needed an inspection of the premises in order to give the correct answer, and could not be told by pamphlets or by form letters. An advertisement could tell how easily and neatly the work was done—how well equipped this particular concern was to do the work so far as careful workmanship and the best of material was concerned, and that there would be no injury to the woodwork or wall paper. The advertisement could likewise tell of the advantages of electric light and could arouse interest and eventually get the prospect to write for additional information, but that was all. After the inquiry had been received, it was largely a question of salesmanship to close the deal.

Soon Required an Assistant

The first few inquiries that came in as a result of the campaign were handled by the contractor himself. He had no man to take care of this work. But the work was too much for him; the inquiries began to come in faster than he could handle them. So he hired a salesman to look after this business for him. First of all, the salesman called on all the inquirers and met with good success in bringing in contracts. Finally all the inquiries were taken care of and the salesman found some spare time on his hands.

The contractor then reasoned—"My advertising may have interested several of the prospects, yet they have not been sufficiently interested to go to the trouble of writing for additional information. People, as a rule, dislike to write letters." So the salesman was started in calling on every one of the 1,000 people from whom no inquiries had been received. The scheme worked well. When the salesman made his call on the prospect and presented his card, the prospect was familiar with the firm he represented as well as his proposition of wiring the home. This much had been accomplished by the advertising.

In addition to the direct-by-mail letters, the contractor took a small space in one of the local newspapers and ran an advertisement three times a week. Very little was said in this advertisement other than giving the firm name, and making a statement that they specified in the wiring of houses. The aim was to acquaint people with the firm—in other words, general publicity.

The results of the campaign were fine. The following year the plan was repeated to those prospects who had not been induced to wire their houses. The contractor felt that these people would be nearer the "wiring point" after having been circularized the previous year with advertising material. He was a firm believer in the fact that every one of the prospects would eventually wire their homes and that

*Read at Electrical Contractors' Association Convention.

it was merely a matter of time before his concern could get them to contract for the work.

The salesman was, first of all, a good salesman. After his experience in this campaign he was much more valuable to the contractor on account of the experience he had obtained. The house-wiring campaign closed and there was little to keep the salesman busy except calling on the few inquirers that came in from time to time. The contractor was anxious to keep the salesman in his employ, and the only way that he could do this was to keep him busy.

The amount of business which he had done in wiring old houses had materially increased, while the wiring of new houses showed very little or no gain over the previous year. So it was decided to use the salesman to bolster up this end of the business.

Again the contractor figured—"This business is handled almost entirely by architects and general contractors. It would be a very easy matter for me to obtain a list of every one of these doing business in my city." From the telephone book's business directory such a list was prepared. A series of form letters was also prepared which were to be mailed to every architect and builder in the city. The contractor realized that the price and the quality of his work had a great deal to do with the obtaining of this business. Consequently the letters told of his reliability as an electrical contractor, the number of years he had been in business, and practically guaranteed them satisfaction if he obtained work from them. The letters also stated that the price was extremely low, taking into consideration the quality of material and workmanship. An opportunity to make an estimate on some of their work was asked.

Salesman Calls Regularly

The salesman then started to call on these people. Not calling once, but calling regularly every two weeks. In the last letter which was mailed it was stated that Mr. Salesman would call on them in the course of a few days. When this call was made they were familiar with the firm the salesman represented and with his mission in calling upon them.

The salesman made it his business to become personally acquainted with the men in these offices; his periodical calling gave him an excellent opportunity for doing this.

The contractor continued his small advertisement in the newspapers—the three insertions a week only costing him $2.00. These advertisements helped to bring the firm name before the architects and builders, and to give it a standing in the community. The architects and general contractors were furnished with self-addressed post-cards, which they could use in requesting that the salesman call on them in order to figure a piece of work.

Requests for bids on small wiring jobs began to come in. The work of wiring new buildings picked up tremendously. The salesman became well acquainted with the prospects. He brought his personality into play and in turn brought in the business. Here was another profitable field which advertising, combined with good salesmanship, has conquered.

(To be continued)

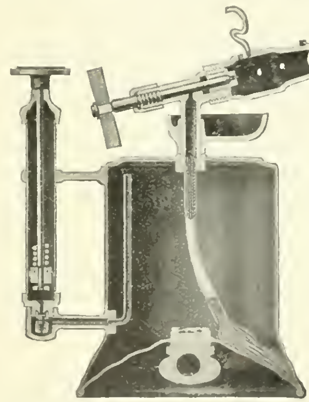
Reacto Horns

A high-grade electric horn of the vibrating type has recently been introduced on the Canadian market by MacKeen Company, 404 Unity Building, Montreal. This horn is constructed on an entirely new principle, with the result that it emits a very different sound from other vibrating types. The armature or hammer strikes the steel diaphragm on its return or re-acting stroke. The action is very quick, so quick in fact that it has not the slightest damping effect on the vibration of the diaphragm, and resulting tone of the horn. The tone is clear, loud and penetrating and free from that abruptness or squawkiness which characterizes many horns. Practically all sparking is done away with, as a condenser is bridged across the circuit. The horn is weatherproof and all the steel and iron parts are copper-plated to prevent corrosion.

The Reacto horn is exceptionally well made and of excellent appearance; the standard finish is baked black enamel with inside surface of the projector finished in nickel. A high-grade nickel push button with water-proof cord is supplied with the ordinary equipment, and when specified a sufficient length of nickel flexible tubing can be supplied for steering post attachment. This horn measures 11 inches over all and the bell mouth of the projector measures 7 inches, the approximate weight being 7 pounds. It is manufactured by the Holtzer-Cabot Electric Company of Brookline, Mass.

A Universal Blow Torch

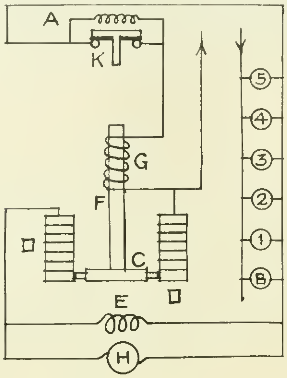
A new gasoline blow torch has recently been placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., which embodies a number of novel features and improvements. These improvements, it is claimed, adapt the torch for all conditions of service and it is therefore called a Universal Blow Torch. A cross-sectional view of the torch is shown in the accompanying illustration. The burner is made particularly heavy so that it will retain its heat and keep the torch burning in cold or windy weather.



The drip cup is made especially deep so that it will start the torch under bad weather conditions. These features, however, do not detract from the use of the torch for indoor work. Another feature is the self-cleaning burner valve. The needle at the end of the valve stem cleans the hole automatically when the valve handle is turned. The valve seat therefore need never be injured by picking at the opening to clean it. The valve seat is a separate replaceable plug. The handle of the valve is of fibre. This handle does not get hot nor does it need a long valve stem for cooling as does an iron handle. On the other hand it will not crack, loosen and come off as does a wooden handle. It does not char or burn. The tank it is claimed, is of the heaviest gauge brass ever used for torch tanks and is reinforced with an extra corrugated brass disc covering the entire inner surface of the tank pot. This insures the tank keeping its shape under very rough handling. The pump valve works in a cylindrical guide which assures the perfect seating of the valve. It can be taken apart and any part replaced separately. The illustration shows the quart size of torch. A pint size is also furnished which differs only in the shape and size of the tank.

Control of Suction Cleaners

The diagram shown herewith is illustrative of a motor driven suction cleaner installation recently completed in the Cecil apartments. Jarvis street, by the Elevator Supply Company. Direct current is used. In the diagram, B. 1, 2, 3, 4, and 5 represent push buttons on the different floors arranged in multiple. E. & H. representing the field and armature respectively of the motor. D D are carbon resistances. G is a solenoid operating a soft iron core F on the base of which



is a hollow metal box C which closes the circuit between the carbon resistances by means of two small brushes. A is a resistance of about 200 ohms and K a metal piece for cutting out the resistance A.

When the current is first introduced it passes through which ever one of the push buttons has been closed and divides, part going by the upper route through K and part by the lower through the carbon resistances, etc. The current in G is sufficiently strong to raise F, gradually cutting out the resistances D D and, as the highest point is reached, raising the contact piece K. After this only sufficient current is allowed to pass through G, as a result of the resistance A which has been cut in, to hold the magnet F in its working position, that is, cutting out the resistance in the lower circuit except that of the armature and the field itself.

New O-B Overhead Materials

The Ohio Brass Company, of Mansfield, Ohio, have added to their line of overhead materials the new designs shown herewith. The cross-over shown in Fig. 1 is intended for use at crossings where it is not desired to insulate the wires from each other. The feature of the device is the method of holding the wires in place by means of the cam action of the renewable bronze tips. This principle has been used on O-B frogs for some time and has proved to be not only an efficient means of holding the wire but also a time saver for the lineman. The bronze pan and cross runner castings interlock and are held together without the use of screws or bolts. Installation of the device is simple and is accomplished without cutting of wires. Two forms are made; form 1, with malleable iron deflector bars to prevent a flying trolley harp from being wedged, is used for crossings of from 30 to 60 degrees, while the form 2, without deflector bars, is for crossings from 60 to 90 degrees, since, within these latter limits, there is no danger of a harp catching. For the present, these crossovers will be furnished in bronze for 2/0 round, figure 8 and grooved wires only.

The bronze splicer shown in Fig. 2 is an entirely new design known as the type C. It combines lightness, strength, clearance for trolley wheel and smooth under-run. The lips at each end of the splicer are bent around the wire, completely encircling it and protecting it throughout the entire length. There are no hollow places in the under side to cause arcing. Installation is easy as the wire is practically straight throughout the entire length of the splicer. The set screws are made of tool steel and are amply large to withstand severe strains. Their holding power is increased by forcing the wire into slight depressions under each screw. Tests have shown that the wire will break before it will slip from the splicer. For the present, this splicer is made for 0 and 2/0 round and grooved wires only.

The type A, form 2 section insulator shown in Fig. 3, was developed as a result of the popularity of the type A, form 1, which has been on the market for a number of years and has been in steady demand. The new design is similar in every way to the old except that it is smaller and lighter. It is recommended for 0 and 2/0 round, figure 8, and grooved wires, while the old heavier design is offered for the 3/0 and 4/0 wires. The insulator is shown with suspension yoke attached to boss, but is furnished with the boss only when it is desired to attach the insulator to the trolley hanger.

The trolley clamp shown in Fig. 4 is made with a pressed steel runner piece, 7¼ in. long, and cast boss. It is light in weight, fits the wire tightly and gives more clearance for the trolley wheel than the ordinary cast clamp. The boss and runner piece are held together by four screws which also tighten the clamp onto the wire. The weight of the trolley wire is supported by two small lugs on the boss castings which fit into a hole in the runner piece and are held by the screws.

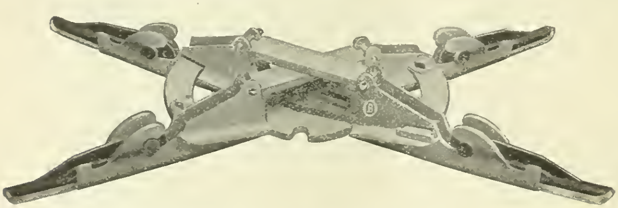


Fig. 1—Type E Adjustable Cross-Over Form 1, with Deflector Bars

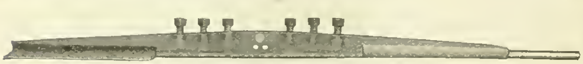


Fig. 2—Type C Splicer—Patent Applied For

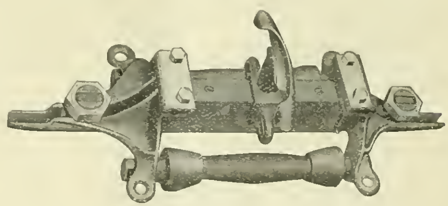
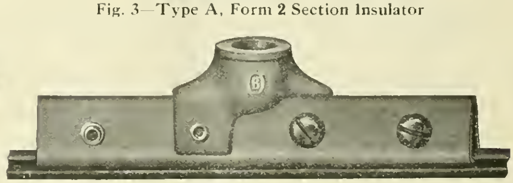


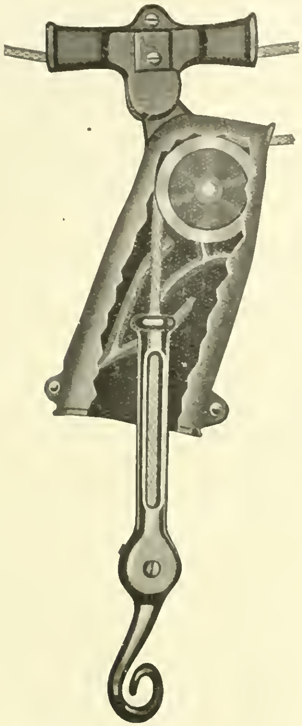
Fig. 3—Type A, Form 2 Section Insulator



Fig, 4—Pressed Steel Trolley Clamp

New Rain-proof and Sleet-proof Pulley

The new "Kyle Line" long-skirted pulley, made by the Line Material Company, South Milwaukee, Wis., is completely covered both front and back, to keep out snow, sleet and rain. Inside of this enclosing case, guide ridges forming a part of the casting, guide the knob of the rope clamp as it is raised, so that the weight of the lamp is finally taken from the rope and is supported by pulley ridges. In the accompanying illustration, in which one side of the enclosure is



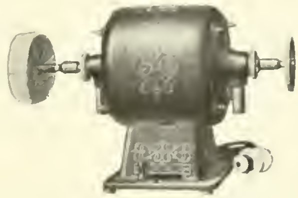
cut away, the guide ridges can be seen and the rope clamp is in the final position. The rope clamp has rounded edges, and offers protection to the rope on both sides from scraping against the pulley. The small clamp can be used with chain or rope. The pig-tail hook, which is a part of this clamp, allows the lamp to be attached with one hand. These safety pulleys are made with five standard types of top clamps for suspension from mast arm, outrigger, ceiling and span wire. In the suspension of span type clamp, as shown in the illustration, the groove for the wire or cable is opposite to that assumed by the span, so that the pulley locks itself in the position in which it is installed and cannot move along the rope. These pulleys are being used with arc lamp insulators, and hangers of all types.

Have a Montreal Office

The George H. Shuman Electric Company, New York, have opened a Montreal office at 1010 New Birks Building, Mr. William Ile being appointed Canadian manager. The company are electrical contracting engineers, and have carried out some extensive contracts. In addition they are the distributing agents for Canada of the Ile-drawn tungsten lamps, which are guaranteed. The company are also making a feature of metallic art fixtures, made of asbestos and plaster, fireproof, and manufactured in various colours.

A New Dental Lathe

The Westinghouse Electric & Manufacturing Company have just placed on the market a new electric lathe specially designed for the use of dentists. It is made for operation on either direct or alternating current lighting circuits and is rated at 1/6 h.p. Alternating current lathes have two speeds, and direct current lathes three. Speed changes are effected by a switch lever at the base, which has also an "off" position, so that the lathe can be stopped and started at the



work. The switch is built of material that is unaffected by moisture. The shaft is extended at both ends for mounting Ritter chucks which carry buffing and grinding wheels of various sizes, drills, burrs, etc. The chucks can be forced off the shaft by turning a knurled nut mounted on each bearing. A double groove pulley is furnished with each lathe. The bearings are specially designed for grinding service and are automatically lubricated by means of grease cups. All the working parts are enclosed and protected from dust and dirt. The finish is especially pleasing, being of glossy black Japan, ornamented in gold, with all bright metal parts nickel-plated.

New Wall Reflector

The Reynolds Electric Flasher Manufacturing Company of Chicago and New York are placing upon the market a specially designed reflector for painted walls, bulletins, billboards and signs of various description. The reflector is supported by wire cables, which in turn are fastened to cross arms at the top and bottom of the sign. A 100-watt mazda lamp is used, and the full force of the light is evenly distributed without shadows or dark spots over 15 square feet of sign surface. The reflector is porcelain enamelled on steel

and has a glassy, white reflecting surface on the inside and is blue on the outside. This material is practically indestructible. They are easily erected by any one, and many a sign which is only doing service in the day time can be turned into a handsomely paying night advertisement by a small expenditure for reflectors and electric light current. This class of business opens up a large field for the central station manager. It is a desirable load, and any live business house should readily be induced to go into the proposition.

Current News and Notes

Athabasca Landing, Alta.

A recent fire wiped out practically the whole town, including the provincial government telephone exchange.

Battleford, Sask.

The municipal electric light management will erect within the next three months, two 250 h.p. engines, and two 250 h.p. boilers, with Westinghouse generators and switchboard, to increase the output of the present plant. The municipality will also purchase within the next three months material for six miles of transmission line. Mr. F. K. Martin is manager of the Battleford municipal electric system.

Brandon, Man.

The municipal street railway system showed a surplus of $4,000 during the month of July, gross being $8,430. This increase is partly the result of the Fair during which record crowds were carried.

Brockville, Ont.

Work has started on the installation of the ornamental standards in connection with the new street lighting system.

Brantford, Ont.

The contract has been awarded to Bennett & Bowden for the erection of a transforming sub-station in Brantford. The necessary transformers and switching equipment will be purchased by the Hydro-electric Power Commission of Ontario.

Cookshire, Que.

The Westbury Electric Light & Power Company of Cookshire, expects to erect within the next few months about 8 miles of transmission lines and to purchase a 200 kw. alternating-current generator, waterwheel governor and 100 watthour meters. The generated voltage will now be raised from 3,000 to 6,000 volts. This company is in process of reorganization into a joint stock company, capitalized at $75,000, Mr. H. A. Worby is manager, and Mr. Elmer Williams, electrician.

Calgary, Alta.

On August 18, the date on which the new Calgary store of the Hudson's Bay Company was formally opened, the entire street car system of the city of Calgary was handed over, for a consideration, to the Hudson's Bay Company. Between 2 o'clock and 6 o'clock in the afternoon no fares were collected on any part of the system.

Carlyle, Sask.

Contracts have been awarded in connection with the power house and generating equipments for the new electric plant as follows: Power house, reservoir and erection of compressor to Bennets, Debnam & Company; pumps, Caledonian Iron Works; generators, General Supply Company, Calgary; meters, Packard Electric Company; poles, McKinnon Lumber Company, Calgary; line material, Northern Electric Company; wire, Eugene F. Phillips Company; transformers, Canadian Moloney Electric Company; street lighting equipment, R. E. T. Pringle. The work is in charge of the Jno. Galt Engineering Company.

Edmonton, Alta.

It has been recently discovered that the city telephone department has suffered considerable loss through the alleged dishonesty of one of its former employees. The full amount has not yet been discovered, but it is not expected to be above a few thousand dollars.

The street cars are now operating over the new high level bridge which has been built over the North Saskatchewan river to connect North and South Edmonton.

It is understood that the first section of the Edmonton Interurban Electric Railway which will operate between Edmonton and St. Albert, will be in service within the next few weeks. Cars of the gasoline electric type will be used, the motive power consisting of a gasoline engine, operating a generator which in turn will operate the motors.

Elora, Ont.

The probable cost of a complete distribution system for the village of Elora is estimated roughly by the Hydro-electric Power Commission at $10,000.

Forest, Ont.

The electrical equipment for the new power plant in Forest is being supplied and installed by the Canadian Westinghouse Company, Limited, and consists of one 70 kv.a. alternating current E. T. generator, 3-phase, 2200 volts, 25 cycles, 500 r.p.m.; one 3½ kw., 125 volt, direct-connected exciter and a two-panel switchboard. Panel No. 1 is designed for the control of the generator and exciter, and panel No. 2 for control of a 12 kw., 2200 volt primary, 25 cycle, constant current regulating transformer. Both panels are mounted with all the necessary instruments.

Fort William, Ont.

Extensions to the development plant of the Kaministiquia Power Company are pending, but no definite decision has as yet been announced nor any tenders called nor contracts let. The nature and extent of these additions will depend somewhat on trade conditions and business prospects of the next few months. The present installed generating capacity has a nominal rating of 15,000 h.p. with overload rating of 22,000 h.p. The hydraulic development, including dams, intakes, forebay, etc., was originally installed for an ultimate capacity of 35,000 to 50,000 horse power.

The contract has been awarded for the construction of car-barn additions for the accommodation of the municipal street railway rolling stock. The cost will be about $40,000.

The city council have adopted a report of the Utilities Committee which recommend that power be sold for domestic purposes at a rate of 1½c. per kw. hour. There is, however, a meter rate of 25c a month attached as well as a minimum charge of $1 per month.

Fredericton, N.B.

The Fredericton Gas Light Company recently purchased a 375 kw. Westinghouse-Parsons turbo-generator which is about ready for shipment from the East Pittsburgh works of the manufacturer. A small direct connected engine-driven exciter is also included in the order. The condensing outfit is being supplied by the Wheeler Condenser & Engineering Company, and consists of one surface condenser with sufficient capacity to look after the exhaust of the above turbine, a circulating pump with a Kerr turbine to operate it, an Edwards air pump and other auxiliary equipment. The switchboard and necessary instruments are being supplied by the Canadian Westinghouse Company, and have already been delivered in Fredericton.

Granby, P.Q.

It is reported that a syndicate in which McCuaig Bros. are interested have purchased power sites on the St. Francis

river near Drummondville, where they can develop some 8,000 h.p. and that power will be transmitted to Granby providing an agreement can be arrived at with the municipality.

Galt, Ont.

The branch of the B. F. Sturtevant Company being established in Galt will not build electrical apparatus at the present time. The work will consist primarily of assembling fans, blowers and heaters, and of building sheet metal work. The castings and parts being sent from the Readville, U. S. A. shops.

Hamilton, Ont.

Tenders are being received by Mayor Allan for extensions to the conduit system in connection with the hydro-electric distribution.

Hull, Que.

The Hull Electric Railway Company held a Venetian Carnival at Aylmer recently which attracted over 2,000 people from Hull, Ottawa and places along the line.

Le Pas, Man.

The contract has been awarded for the construction of the building to house the operating equipment of the wireless station being installed here, for the Dominion Government, by the Marconi Telegraph Company. The contract goes to Coyle & Hughes, of Winnipeg.

Lindsay, Ont.

On September 3 a by-law will be submitted authorizing an agreement between the Light, Heat & Power Company and the municipality regarding street illumination. The company agrees to maintain the present system of 77 6.6 amps. carbon arc lamps and 18 6.6 amps. magnetite arcs for the annual sum of $5,200. If further lamps are required the prices will be as follows:—magnetite arcs $75, carbon arcs $50, 60 candle tungsten $12, per lamp per annum.

London, Ont.

It is probable a vote will again be taken on the question of operating Sunday cars. The date has not yet been set, but it will likely be with the other January elections.

Medicine Hat, Alta.

It is reported that active construction work in connection with the street railway system will be commenced in the very near future.

Montreal, Que.

The Hon. Jules Allard, Minister of Crown Lands for the province of Quebec, has received a petition signed by a large number of citizens of the Eastern Townships asking that the government build storage reservoirs to hold the waters of the St. Francis River in order to regulate the flow. They also ask that the Commission on Running Waters study the problem.

Tenders have been received for additional sections of the Montreal conduits. For the work on St. Catherine street from Atwater Avenue to Guy Street. Six tenders were sent in—L. A. Ott; G. M. Gest, Dietrich, Limited; Federal Engineering Company; C. E. Deakin; and Standard Construction Company. The other section is on Bleury street to Pine avenue, and for this three bids were made—G. M. Gest, Standard Construction Company, and L. A. Ott. Mr. G. M. Gest was the successful tenderer on both sections, his prices being the lowest in both instances. For the St. Catherine Street, Atwater Avenue to Guy Street section Mr. Gest's quotation was $45,969; time for the job two months. For the Bleury Street section, the price was $128,418; time four months.

Some controversy has arisen between the Outremont P.Q., Town Council and the Bell Telephone Company as to the payment of certain sums for the laying of the joint conduit. The amount is about $4,000, extras for which the company disclaimed responsibility. The company, however, agreed to allow Dr. Herdt, who designed the conduit, to arbitrate, and the council have decided to accept the suggestion.

Another extension of the Montreal and Southern Counties Railway is completed. This is to Marieville, four miles beyond Richelieu and 22 miles from Montreal. Much of the roadbed to St. Cesaire is also completed.

In connection with the Montreal conduit system, Mr. Parent, superintendent of lighting for the city, has prepared a report recommending a lighting system for the various streets. A number of artistic standards have been considered, and Mr. Parent has also made a study of the most suitable systems.

The Siemens Company of Canada have been awarded the contract to supply 41 motors ranging in capacity from 185 h.p. down, for the Acadia Sugar Refinery Company of Nova Scotia, in connection with their new plant. The motors are to be suitable for 3-phase, 60-cycles, 550 volt circuits.

A contract has been awarded to Mr. E. G. M. Cape, Montreal, for the construction of a new factory and offices for the Imperial Wire and Cable Company, Montreal. The building has been commenced on the site at St. Patrick street. The factory and offices will comprise several structures, the principal being one of eight storeys. When completed, the factory will be one of the largest and best equipped in Canada. The machinery will all be run by electric power.

Neepawa, Man.

The town of Neepawa will call for tenders in the near future for apparatus, consisting of two 150 horse power boilers and a generator unit of 125 kw. capacity, direct connected to a suitable engine. Plans and specifications are now being completed by W. E. Skinner, Limited, 204 Sterling Bank Building.

Newburgh, Ont.

The Sebley Telephone Company, Limited, has been incorporated with a capital of $5,000, to carry on the general business of a telephone company, with head office at Newburgh.

New Toronto, Ont.

By a recent vote the council was authorized to issue debentures to cover the cost of erecting a distribution plant.

Ottawa, Ont.

The application of the City of Ottawa for an order compelling all companies owning and operating overhead wires on the chief streets of the city, whether for electric light, telephone or telegraph, to be buried underground, will come before the Railway Commission at their first sitting in September.

Port Hope, Ont.

On August 25 a by-law was carried authorizing the agreement between the Seymour Power & Electric Company and the Corporation of the town of Port Hope. By the agreement the company supplies an electric street lighting service to the extent of a minimum of 340-60 candle power tungstens at an annual rate of $12. The company will spend about $10,000.

Prince Albert, Sask.

Owing to the general financial condition which has rendered it difficult for many municipalities to get the necessary money to continue their municipal work, the city of Prince Albert will temporarily suspend construction work on their hydro-electric development at LaColle Falls. The dam is already nearing completion and is understood to be in such

shape that the delay will not cause any deterioration of the structural work.

Regina, Sask.

The operating returns for the week ending August 2, show revenue $7,036.60 and the number of passengers, not including transfers, 166,311. For the week ending August 9 the figures were $3,909.30 and 91,782.

A contract has been awarded to the Canadian Allis-Chalmers Limited, for two motor driven centrifugal pumps of a capacity of 12,500 gallons per minute each.

Tenders will be received up to October 1st for boiler room equipment in connection with Regina's new power house.

Sherbrooke, P.Q.

The city recently acquired the Lomas power, on the Magog river, situated above the present municipal power station. This opens the way for a further development which may be rendered necessary in the near future, as the consumption of current for light and power is steadily increasing.

Souris, Man.

A by-law will be submitted on September 2nd authorizing the expenditure of $40,000 on an electric light and power plant.

St. Catharines, Ont.

The Chatfield Heating & Plumbing Company has been formed to carry on, among other things, the business of electricians, mechanical engineers and manufacturers.

Contract has been awarded to Newman Bros., St. Catharines, for the erection of a transformer station here for the Niagara, St. Catharines and Toronto Railway Company.

The by-law authorizing an agreement with the Hydro-electric Power Commission of Ontario, which was to have been voted on on August 28, has been postponed to allow further time to prepare certain necessary estimates.

St. Agatha, Ont.

Niagara power was turned on for the first time at this point on August 6. The supply line runs out from Berlin, which is eight miles distant.

Sudbury, Ont.

By a recent vote the electors were unanimously in favor of granting a franchise to the Sudbury-Copper Cliff suburban electric railway.

Swastika, Ont.

C. A. Foster, of Haileybury, contemplates the installation of a seven mile telephone line between the Swastika and Foster properties taking in all the mines along the way. A central station will likely be installed at Kirkland Lake.

Sandwich, Ont.

The frequent reports that a power plant is being constructed in Sandwich to operate in conjunction with the Detroit Edison Company are inaccurate. A small sub-station has been erected which presumably was intended to receive power by cable from Detroit, but up to the present time the Ontario Government has not given its consent to the importation of power at that point.

Toronto, Ont.

The Turbine Equipment Company, Limited, has been incorporated with a capital of $40,000, to carry on business as civil, mechanical and electrical engineers, contractors, etc., with head office at Toronto.

The Lancashire Dynamo & Motor Company will change their address, on September 1, from the Peterkin Building, Bay street, to 107-9 Duke street. In their more commodious quarters, rendered necessary by business expansion, they will have ample space for a store and show room and a small repair shop, in addition to offices.

Something over four millions of debentures in connection with the Toronto Hydro-electric distribution system have been placed with Messrs. N. W. Harris & Company, of New York. These debentures bear interest at 4 per cent. and the sale price was 83.

Valleyfield, Que.

An electrical fire alarm system is being installed at Valleyfield, P.Q., by Sevigny & Lalonde, Notre Dame Street West, Montreal. The equipment consists of Gamewell non-interfering Excelsior fire alarm boxes connected in series, supplied by the Northern Electric and Manufacturing Company. The town is divided into four districts, five boxes being installed in each division, these being connected to the central fire station and also to the waterworks. The system is worked by means of two closed metallic circuits, north and south, which can be used together, or separately in case of necessity. The electro-motive force for operating the system is furnished by gravity batteries, of sufficient power to give 1-10 ampere for each circuit. Lightning arresters are provided in each station, while a switchboard is installed in the central station. The gongs are of the 15 in. and 8 in. types.

Wallaceburg, Ont.

The Wallaceburg Gas Company are installing a new 250 kv.a. generator. This will be operated by a 150 h.p. gas engine on one side and the present steam engine unit on the other side. A change is also being made to 60 cycles and 24 hour service will begin on October 1 next. The Premier Electric Light & Power Company and the Consumers' Gas Company have amalgamated and are now known as the Wallaceburg Gas Company. Mr. W. R. Waghorne is manager of the company.

Wardner, B.C.

The electric power house of the Crows' Nest Pass Lumber Company at Wardner was recently destroyed by fire.

Winnipeg, Man.

The municipal system of the city of Winnipeg is at present being extended by the installation of two 5,000 kw. water turbine generator units. A single 9,000 kw. 3-phase transformer is also being installed. Up to the present time the transformer equipment at the generation station has been single phase built for 6,000 volts, but all future equipment will be installed for 110,000 volts, 3-phase. A second transmission line is also to be erected and work on the footings will be commenced in the immediate future. This will be a steel tower using suspension type insulators similar to those used on the Ontario Hydro lines. It is not the intention to use this line for 110,000 volts at the present time, but equipment is being installed for ultimate use at that pressure.

Welland, Ont.

It has been stated that construction work will be commenced this autumn on the plant of the Electric Steel and Metals Company, which is to be built here.

Woodville, Ont.

A by-law was passed on August 13th authorizing the expenditure of $4,000 on a distribution system.

Wolseley, Sask.

A by-law was submitted on August 20 authorizing the town council to purchase the plant of the Central Light & Power Company, Wolseley, Sask. The sale price is $14,000. Failing an agreement with the municipality the company will install a 30 kw. generator which will be belted to their auxiliary oil engine so as to relieve the present generator. It is also the intention to install, next year, a new 150 h.p. producer gas engine and a 90 kw. generator complete with a suction gas producer. Mr. Chas. Stengel is manager of the company.

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The Self-Contained Car in Practice

Sufficient experience has now been gained with cars of the self-contained type that their success is no longer a matter of conjecture. In reliability of operation and reasonable cost of maintenance, expectations appear to have been more than fulfilled and the rapid increase in the number of installations also indicates that this type of car is meeting the requirements of certain kinds of service in a very satisfactory manner.

A paper printed elsewhere in this issue gives details of the developments leading up to the modern type of gas-electric car and also shows by statistics, the extent to which this class of equipment is now being used in the United States. Operating figures are also given in two typical systems where the cars have been operating for some time. These latter are particularly interesting as indicating that the estimated figures on operating costs are being more than fulfilled, even though the conditions surrounding operation can scarcely yet be quite normal. On the two systems in connection with which figures are quoted the general practice has been to operate two-car trains—a motor car and one trailer—and these figures show costs per motor-train-mile in no case exceeding 18 cents. The cost per car mile works out to slightly more than 13 cents.

In two out of three cases quoted the item of wages is considerably the largest item, running anywhere from 30 per cent. to 40 per cent. of the total operating expense. Fuel cost comes second, these two items representing about two-thirds of the total. Of three cases quoted the number of gallons of fuel (naphtha) per motor-train-mile is given, respectively, as .72, .75, .75; the number of gallons per car-mile is given in two instances as .49 and .52. The fuel phase of the question is an important one and advances in this direction, which are likely, must result, almost in the same proportion, in further popularizing the self propelled car for interurban service.

Public Utilities Accounting

One of the weaknesses underlying the control of public utilities by municipalities is the lack of a sufficiently accurate or standard system of keeping account of the cost of operations. It is to be supposed that every municipality is anxious to so conduct its financial affairs that the promise of the present will be borne out by future events but how often have we seen it happen in Canada, within the last decade, that the roseate prospects and promises of the first year or two of a municipal public utility's operation is followed by a period of deficits, unsatisfactory service, resignations of disappointed operators, public criticism, etc., all of which might, possibly, have been avoided if a more cautious, systematic course had been mapped out at the start. Much of this, no doubt, can be charged to lack of system, a weakness which for the time being, deceives those in control and leads to unjustified statements regarding earnings and surpluses.

In a paper printed elsewhere in this issue Commissioner Robson of Manitoba makes a plea for the establishment of a standard system of accounting of public utilities and takes occasion to include also privately as well as municipally owned systems. He argues that, in either case, the public is in a sense, a co-partner in the business and, as such, entitled to the fullest information; that it will be a distinct protection to honestly administered utilities; that it would be a means of defense against unfair attack; that the information is needed before a correct judgment can be made regarding further expenditure; and finally that this applies equally to privately or municipally controlled systems. The Commissioner briefly outlines a system of bookkeeping which is at the same time simple and efficient and enumerates what the different Canadian provinces have accomplished in this respect.

For the most part the article will appeal to those in charge of public utilities as reasonable and helpful. There is however a very natural feeling existing in the minds of many of these operators that the "general public" is much better without this kind of information inasmuch as their interpretation is not likely to be either accurate or judicial. Accounts, by all means, should be kept properly and should be free of access to the proper authorities, but an accounting to the news-paper public looks to be a ridiculous proposition in the present state of our mathematical civilization.

Long Sault Development

The Dominion Government has just issued a voluminous report setting forth at length the developments to date regarding the proposed use of the water power at the Long Sault, St. Lawrence River.

During the last two or three years a very active campaign has been waged by the Long Sault Development Company, and others, to obtain the privilege of constructing a generating plant at this point. The following paragraphs from the introduction indicates at the same time the cause of the preparation of the report and its scope.

"The question whether private corporations and individuals shall, or shall not, be permitted to construct works for the development of power in the St. Lawrence river, is one of vast importance to the people of Canada. The present is deemed an opportune time to review the facts. The great possibilities of injury to the interests of Canada, the enormous potential values of the franchises; the possibility that, within the lifetime of many men now living, electrical heating will, in Canada, supersede in part the burning of anthracite coal; the certainty that, within a few years, it will be possible to

economically transmit electrical energy to much greater distances than at present, thus bringing southern Ontario and western Quebec, and the cities of New York, Jersey City, Newark, Boston, New Haven, etc., within economic radius of the rapids of the St. Lawrence; these, and many other considerations demonstrate that to conserve her greatest interests, Canada should adopt a well-considered and cautious policy.

"In this connection the activities of the Long Sault Development Company, which, during the last few years, has been seeking to acquire a franchise for the development of the Long Sault rapids in the St. Lawrence are of interest.

"In order to understand the true import of the Bills on behalf of the Long Sault Development Company presented to the United States Congress and to the Parliament of Canada it is necessary to make a brief study of the various other interests which are combined and associated with that company. In the following report the principal facts essential to such study are set forth."

Montreal Electrical Society

By permission of the Montreal Light, Heat and Power Company, members of the Montreal Electrical Society on Saturday, September 6, visited the company's power plant at Richelieu, P.Q. A special car of the Montreal & Southern Counties Railway was engaged, the party numbering about 100. Mr. P. T. Davies, the ex-president of the society, conducted the members over the plant, and explained the equipment. The plant was designed and erected by the Stillwell-Beirce and Smith-Vaile Company, Dayton, Ohio, in 1897.

In a statement made prior to the inspection, Mr. Davies pointed out that the installation was interesting from the point of view of its age, it being one of the oldest water-power stations in Canada. It had not been materially changed since it was built. The River Richelieu was, before the dam was constructed, 20 feet lower than at present. The machinery consisted of two old types—part of the generators were built on the S.K.C. system (they were supplied by the Royal Electric Company, Montreal). In addition there were four generators supplied by the Canadian General Electric, these being 2-phase, 2200 volt. The normal output was between 10,000 and 12,000 horse power, but more could be carried if required. The transformers (by the Westinghouse Company) were air-cooled by means of Sirocco fans. There was a 40-foot head of water. The current was stepped up from 2200 volts to 25,000 volts, and converted from two-phase to three-phase.

The turbine equipment consisted of horizontal water wheels enclosed in pits. There were four lines from the station to Montreal, a distance of about twenty miles. The four cables of 25,000 volts had never given any trouble. The governors were of the Lombard type, and the company had replaced the individual oil pumps on each governor by a central pump which had been entirely satisfactory. The ice situation needed very careful handling, and two years ago the suspension bridge below the tail-race was carried away, but the experience gained since the construction of the plant had enabled the company to control the situation satisfactorily.

After the inspection the visitors spent an hour at the residence of Mr. Davies and were supplied with light refreshments.

The suburban railway line connecting Sutherland with Saskatoon is almost completed and it is expected the line will be in operation during October. The expense of construction has been borne by certain real estate operators who expect to reap dividends in the increased value of their land. The line will be presented to the city of Saskatoon who will operate as part of their system.

Renfrew's Municipal H. E. System

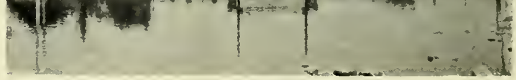
The new hydro-electric plant for the town of Renfrew, Ont., which is situated on the Bonnechere River, a tributary of the Ottawa, was recently placed in operation. The capacity of the plant is 500 kw. but as sufficient water is not always available, it was deemed advisable to install auxiliary steam equipment in the same station, this latter being of sufficient capacity to operate one of the generators. A complete description of the equipment installed in this plant follows.

The general plan of this power plant has already been illustrated in earlier issues of the Electrical News. The dam

Municipal power house, Renfrew

is built immediately above the old traffic bridge with the idea that at some future date the bridge will be rebuilt to suit the town's growing requirements. This dam is of the stop-log type and will serve to a considerable extent as a means of regulation of the water supply. The stop-logs are handled by a hand operated travelling winch.

The headrace is some 350 feet long. There is only one retaining wall, which is on the river side of the headrace, the old shore line being the other side. Three racks at the power house guard the entrances to the two power units, and also to the water wheels operating the turbine driven pump. The clear water pipe extends from the old pumping station down the left bank of the river to the dam, crosses the river under the dam and down the centre of the head race



Dam, intake side, Renfrew town plant

to the pumps, from which it is pumped through the pressure filters into the town main.

All the construction work is carried out in concrete either mass or reinforced with the exception of the power house building, which is of cement, brick outside and red brick inside.

The turbine equipment consists of two horizontal type, double wheel, centre discharge, reaction units, supplied by

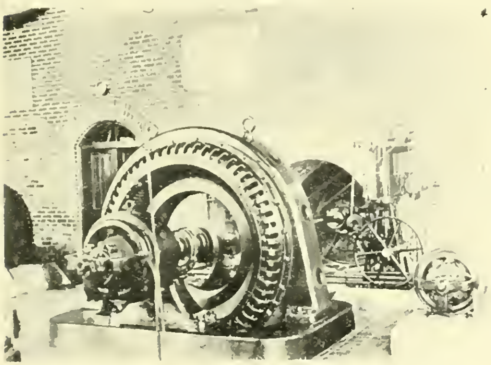
the S. Morgan Smith Company, of York, Pa. These are built to operate under a 36-foot head at 400 r.p.m., and are calculated a maximum of 400 h.p. per unit.

Generators are horizontal type, 60-cycles, 2-phase, 2,300 volt, 400 r.p.m. revolving field water-wheel type, of 250 kw. 25 per cent. overload. They were supplied by Messrs. Kilmer, Pullen & Burnham, Canadian agents for the Swedish General Electric Company. One of the generators carries its exciter on the same shaft. A second exciter is so placed that it can be belt connected to either generator.

Owing to the varied flow of the Bonnechere River and also to guard against interruptions to the power supply from other causes, the precaution has been taken to install an alternative prime mover in the form of a Belliss and Morcom steam engine of sufficient capacity to drive one of the generators. This particular generator therefore can be connected either with a water turbine, or if occasion requires, with a steam engine.

The boiler room equipment consists of 2 boilers of 75 h.p. each, transferred from the old plant and a new 150 h.p. boiler. The boiler plant is fitted with motor driven fan for induced draft and is capable of raising a full head of steam from cold water in less than one hour.

The pumping equipment consists of one Drysdale turbine pump with a capacity of 1,100 gallons per minute at 110



One generator, exciters and governor, Renfrew.

pounds pressure. This pump is direct connected to an S. Morgan Smith double runner turbine. Provision is further made for duplicating this equipment. There is also installed a Canada Foundry motor-driven turbine pump which has been transferred from the old pumping station and has proven capable of delivering 700 gallons per minute.

Special care has been taken in the design of the dam to prevent ice troubles. At the entrance to the flume submerged arches have been installed, similar to those now in use at the Mississippi River Power Company's plant at Keokuk. The curtain wall of the Renfrew plant differs from others however, in that it is inclined up-stream at an angle of some 40 degress to the horizontal. As a further precaution the racks at the power house are wholly submerged in order to prevent radiation.

The town plant is so constructed that it can operate in co-operation with the plant of the Renfrew Power Company. The generating equipment in the latter's station is water power driven by about 700 kw. capacity, 2 phase, 60 cycles, 2,300 volts. The generators are C. G. E. manufacture.

The governors provided for the regulation of the turbines are of the Lombard type. The switchboard consists of 8 panels of blue Vermont marble 2 inches thick, 65 inches high x 24 inches wide, designated as follows:—1 house lighting panel, 2 power panels, 1 arc lighting panel, 1 exciter panel, 2 generator panels and 1 spare.

The plant was installed under the immediate direction of Mr. J. R. Stewart, town engineer of Renfrew. Mr. J. B. McRae, of Ottawa, was the consulting engineer.

A Farmer's Isolated Plant

At Alberton, P.E.I., a small generating equipment operated by a gasoline engine, has recently been installed by the Canadian Fairbanks-Morse Company, for Mr. B. I. Raynor, the owner of two large fox farms.

The equipment consists of a gasoline engine, a generator capable of lighting continously 50-12 candle power tungstens, a switchboard, and an auxiliary battery. Photographs taken of this installation are shown, herewith, in Figures 1, 2, and 3.

Dynamo

The dynamo is a Fairbanks-Morse compound wound multi-polar self-regulating machine, having a capacity of 25 amperes at 32 volts. It is heavily and sturdily built, the aim being to produce a machine that will not merely give its rated capacity for a temporary period, but will continue to give efficient service for years without causing the expense and inconvenience that would be incidental to cheap and light construction. It gives a steady, brilliant light, and regulates automatically, producing only the amount of electricity required, whether its entire capacity or only a single light may be burning, thus saving the consumption of fuel when running only a part load. The current generated is of low voltage and is entirely harmless so that any unpleasant results from accidental contact with uninsulated parts of the machine are avoided.

Engine

The engine is the Fairbanks-Morse 2 h.p. special electric oil engine and is designed and constructed for this service. It is of the 4-cycle type, with throttling governor, extra heavy fly wheels and bearings and an efficient lubricating system which permits of its operating for long periods with little attention. Its regulation is exceptionally close, as required for electric lighting service, and the special governor permits of directly driving a standard dynamo without resorting to extra balance wheels.

Storage Battery

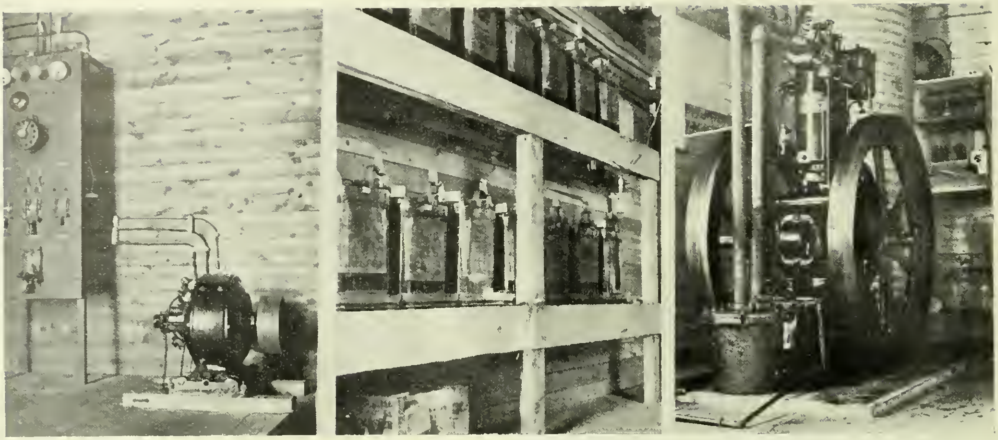
The storage battery consists of 16 cells of the Electric Storage Battery Company's chloride accumulators. The battery, when fully charged will furnish enough electricity to run 9 lights for 7½ hours, 13 lights for 4¾ hours, 18 lights for 2¾ hours or 30 lights for one hour. When fully discharged it requires about ten hours to completely recharge it. Under ordinary conditions of service, most of the lighting being done direct from the dynamo, the battery need be completely recharged only once or twice a week.

Switchboard

The switchboard is a handsome marine finish slate slab, mounted upon angle iron supports and provided with wall braces which hold it at a suitable distance from the wall. On the face of the panel are mounted the following instruments:— 1 voltmeter; 1 ammeter; 1 double pole, double thrown mainline switch with fuses; 2 double poles, double throw battery switches; 1 rheostat for adjusting the voltage of the dynamo; 2 pilot lamps, with battery charging resistance; 12 voltmeter receptacles; 1 four-point voltmeter plug, 1 underload circuit breaker.

Other Uses

While especially designed for electric lighting, this plant



A private plant at Alberton, P.E.I.—From left to right, switchboard, generator, batteries and gas engine

provides many other conveniences, and may be used to operate a wide variety of labor-saving devices. Power for any purpose is available wherever the plant is installed, by simply attaching another pulley to the engine, which can then drive a pump, saw wood or operate other light machinery. Electric motors render this power available at points distant from the plant. The engine or an electric motor may be used to drive a compressor and thus make water, fresh from the well, instantly available at any desired point. The plant may also be used to operate electric flat irons, washing machines, sewing machine motors, electric fans, vacuum cleaners or even do light cooking.

Power Development at Long Sault

Extracts from Recent Report of the Commission of Conservation on the Long Sault Project

"To the cursory reader it would appear that one of the principal purposes of the Charter held by the Long Sault Development Company purports to be the improvement of navigation. The preamble of the Act, for example, states that it is:

"For the purpose of improving the navigation of the St. Lawrence river."

And, again, for:

"the permanent improvement of navigation of the St. Lawrence river at and above and below said place."

The Charter, however, does not stipulate or impose upon the Company any specific requirements for the improvement of navigation. It only recites that:

"The navigation of the St. Lawrence river . ... shall be preserved in as good condition as, if not better than, the same is at present, regard being always had to the amount of the natural flow of water in said river as affecting its navigability from time to time."

As the Federal Government of the United States has paramount jurisdiction over navigable waters, the Act of the New York State legislature, Chapter 355, Laws of 1907, requires that the Company shall obtain authority from the Congress of the United States to construct the dams, locks and canals referred to in the Act, and then, the Act further provides, that, after receiving proper authority from Congress, the Company may have, on application therefore, a formal grant of title to the portion of the bed of the river that is to be covered by the structures, and the Commissioners of the Land Office are commanded to make such conveyance. Not only the charter, but the privileges granted, are unlimited as to time.

The Long Sault Development Company, when it shall have complied with the requirements of the Federal law, and upon the terms prescribed by the statute, will—to use the statement made by the Company before the Committee on Rivers and Harbours:

"become vested with (a) the tile to that part of the bed of the St. Lawrence river which it is necessary to use in the construction of the works contemplated by the Act, and (b) the right to construct and maintain such works and to enjoy to the exclusion of all others the right to divert and use for purposes of operating its works, the surplus waters of the St. Lawrence river; subject, however, to such regulation either in respect of the character of the works or the use of the water of the river as the Federal Government (and to some extent, pointed out below, the State Government) may from time to time impose in order to maintain unimpaired the navigability of the river."

It will therefore be perceived, that the primary object of the Bills that have been introduced, and those that are at present before the Congress of the United States, is to secure the Federal authority specified in the Act which the Long Sault Development Company obtained from the state of New York. Once this authority has been obtained, the Company may have, on application therefor, a formal grant of title to the portion of the river-bed that is to be covered by its structures, canals, etc. Such a grant, apart from international considerations, would practically give the Company domination of the situation.

Present Danger in Proposal to Dam the South Sault

"The great danger at present—and it is a real danger—to Canada's rights in the St. Lawrence river, consists in the desire on the part of, and the efforts being made by, the Long Sault Development Company to construct a dam in the South Sault channel. The Company also proposes to construct a power house and lock across the channel, between the foot of Long Sault island and the main shore. This is part of the Company's large project to utilize the whole power that can be developed at the Long Sault.

This important project involves the erection of a dam some 3,800 feet long, between Barnhart island and the northeasterly end of Long Sault island. The channel between Barnhart island and Sheek island is to be widened to ap-

proximately 1,000 feet in width, and used for a power canal to convey water to the forebay of the power works which it is proposed to erect at the eastern end of Barnhart Island. At this point it is proposed to build a dam, having the shape of the letter V, approximately 1,450 feet long and adjacent, on the Canadian side, to Lock 20 of the Cornwall canal. It is proposed at this Barnhart Island power-site to utilize a head of about 40 feet. The proposed dam in the South Sault channel would utilize a head of about 35 feet.

The Company may also find it desirable to raise the level of the dam in the South Sault channel, so as to back the water up at the intake of the present canal leading to the power house at Massena, N.Y. The nominal head at the Massena power house is about 30 feet, but it is stated that some three or four feet of head is lost in the canal. At the present time this Massena power canal is being enlarged by dredging to permit the passage of an increased quantity of water to be delivered at Massena, where a new power house is under construction.

With respect to the extensive development proposed by the Long Sault Development Company, it is interesting to note the statement made, before the Committee on Rivers and Harbours of the United States House of Representatives, by Mr. James W. Rickey, Chief Engineer of the Company.

> "This entire development," said Mr. Rickey, "is laid out with the idea of utilizing every bit of power that is available at this point ultimately—perhaps not while we are alive—but there is nothing done in this entire development that will hinder the complete development of the potentiality of the St. Lawrence river at this point. That is really a very important factor. Many water powers in the past, and comparatively a short time ago, have been imperfectly developed; they have just skimmed the cream off and prevented a complete development."

And, with regard to the project, Mr. G. R. Malby, who has introduced bills into Congress for the Company, says:

> "There is just one more point. There seems to be some idea that the water which goes to the north of Barnhart Island is to be developed half in Canadian territory. If you get on to the scheme you will see that is not quite correct. The proposition, as Mr. Rickey will point out, is that the great power house of the entire scheme is wholly in American territory, at the foot of Barnhart Island; although the water itself passes through a portion of Canadian territory, the development takes place in the United States."

If the "great power house of the entire scheme is wholly in American territory" it does not, on the face of it, appear that Canada would have any control whatever over the Company.

Conclusion

"The Commission of Conservation opposes the granting of any charter to dam the Long Sault, on the following grounds:

(1) Inasmuch as the Ashburton treaty provides that "the channels in the river St. Lawrence on both sides" of Long Sault, Croil and Barnhart islands "shall be equally free and open to the ships, vessels and boats" of Great Britain and of the United States, no constructions which would interfere with navigation in the slightest degree can be erected in any of said channels without the consent of Great Britain.

(2) It is quite possible that serious damage would result from the construction of the works. Engineers have, it is true, given an opinion that there is no probability of such damage. On the other hand, the opinion of the residents along the shore and the most experienced navigators and observers is apparently almost unanimous in holding that the probability of serious damage is very strong. With all respect to the engineers who have given their opinions, it is submitted that the question is not an engineering problem and that no data exist for the formation of a reliable engineering opinion. No engineer can tell where or how ice will be formed when in our rigorous climate the flow of a mighty river is interfered with. It is a fact that slight interference has in former years caused great damage from floods and ice jams. The possible total stoppage of the flow of the river as a consequence of the works contemplated is a contingency which cannot be said to be impossible or remote. Such a stoppage would cause enormous damage to private property and would imperil the Cornwall canal, which is an integral and essential part of the all-Canadian water route from Lake Superior to the sea.

It does not appear necessary to express an opinion as to whether the weight of evidence or probability is in favor of the view expressed by the engineers or that expressed by the residents of the locality who have intimate knowledge of the history of the river for many years past. The fact that there is any—even the slightest—difference of opinion is a sufficient reason for condemning the proposal. No risk whatever should be incurred in a matter of such vital importance.

(3) The proposed diversion of water by the dam between the Long Sault island and Barnhart island would take from the main navigable channel between Barnhart island and the United States mainland about 50 per cent. of its water. The effect of such a diversion of water from the navigable channel is impossible to estimate. It can, however, be stated with certainty that the navigability of the channel would not be improved by such diversion.

(4) The construction of the dams in question will result in compelling navigation (other than by the Cornwall canal) to follow a new route known as the South Sault channel. Experienced navigators are of the opinion that this route will be much inferior to that now followed.

(5) The time will undoubtedly arrive in the history of Canada when deeper navigation upon the St. Lawrence will require to be provided for by the Canadian Government. Should the works proposed by the St. Lawrence Power Company be constructed, the government would no longer have a free hand in undertaking such an enterprise.

The vested rights of the company would require to be considered. Should the engineering plans adopted for improving and deepening navigation interfere with or damage the works of the company, which is reasonably certain to be the case, then the government would be under the necessity of expropriating such works and paying an enormous sum by way of damages. Moreover, it is not clear that such expropriation could be had on any terms. The international character of the works might prove an insuperable bar, in which case the government would be without remedy, and the improvement of navigation could not be effected.

(6) The proposed scheme of the St. Lawrence Power Company contemplates making use of the Canadian side of the river simply as a convenient landing place for a dam. A very slight examination of the plans of the company is sufficient to make it clear that only a small portion of the contemplated expenditure will take place in Canada and only a very small proportion of the total power developed, will be developed in Canada.

(7) Looking at the whole scheme, it does not appear that any serious attempt can be made to show that Canadian requirements or Canadian interests are an appreciable factor in the plans of the company. The plans contemplate the absolute monopolization of the whole power available from the rapids with a minimum consideration of Canadian interests.

(8) No market exists at the present time upon the Canadian side for the power proposed to be developed, or for any appreciable portion thereof. When any large quantity of power is required in the territory tributary to the proposed works it can be otherwise provided. There is, within the

radius of economic transmission, abundant power available for development in purely Canadian territory without interfering in any way with the St. Lawrence river.

(9) Should the time come when further power is demanded by Canadian interests, and the placing of a dam across the St. Lawrence river is determined upon, one-half of the power to be generated thereby will belong of right to Canada and should be permanently retained for Canadian use without any exception or qualification.

(10) The suggestion that power can be generated on the American side, or generated on the Canadian side and exported to the United States, and that thereafter, when it is required in Canada the company can be ordered to deprive its United States customers of the power and deliver it in Canada, is regarded as being entirely illusory. If the power is used in the United States, industries will be built up and vested interests created thereby, which it will be impossible to ignore. The attempt to enforce an order for the delivery of power on the Canadian side after it had for years been exported to, or used in, the United States would lead to serious difficulties. The case is not the same as if the company and its works were wholly within Canada. If the company desired to avoid or resist such an order, no means would exist of enforcing it without resorting to steps which would be a sure road to international complications.

(11) Although not at present required for actual use, the power possibilities of the St. Lawrence at the Long Sault are very great, and the time will undoubtedly come when they will be of enormous value. The present proposition contemplates giving away this valuable asset, without any substantial consideration, to a foreign company for its private financial advantage.

(12) The obvious conclusion from the facts above recited seems to be, that the plain duty of Canada is to maintain her rights of ownership and jurisdiction absolutely unimpaired and untrammelled."

Motor-Driven Fire Pumps

By Mr. H. P. Reed

While the squirrel cage motor has been used in a few instances for the driving of fire pumps, it's starting characteristics make it inferior to the slip ring type motor for this service. Since it is necessary that the fire pump be started without chance of failure, when needed, the motor equipment and control have received more than ordinary attention.

A book of rules issued by the National Board of Fire Underwriters covering all types of fire pumps was published in 1904. These rules have been partially, at least, superseded by the rules made by the same Board in 1911. The 1911 rules bear the title "Rules and Requirements of the National Board of Fire Underwriters for Centrifugal Fire Pumps," and they require a switchboard controlling the motor to contain a suitable switch, a voltmeter, an ammeter and a circuit breaker. These parts are in addition to the starting apparatus. The rules also require that the switchboard must be protected from water coming in from the possible leakage or breakage of any connections at the pump or other piping in its vicinity. These specifications give in general the requirements for the control board. Much is left to the contractor or pump builder, for he must decide upon the type of motor to use.

There are two types of alternating current motors that have been used for fire pump work; the "squirrel cage" and the "slip-ring" type. It is generally conceded that the squirrel cage motor is adaptable to many installations due to the fact that it has not the complications of a slip-ring motor. The brushes on a slip-ring motor are liable to spark and the starters for a slip-ring motor necessarily have arcing contacts. For fire pump service, however, where the motor and controller are always properly enclosed, the objections to the slip-ring motor are overcome and there are many reasons why this type of motor is better adapted to fire pump work.

From an engineering and from a safety viewpoint, the squirrel cage motor is rather undesirable. The principal objections to this motor are its high starting current and its low starting torque. Combined with these features is the fact that it is impossible for an unskilled operator to accelerate a squirrel cage motor without danger of taking a very high current from the line and the possibility of tripping the circuit breaker. In times of excitement when there is a fire and when the night watchman is liable to be called upon to start the fire pump, he will not wait sufficiently long on the starting "tap" for the motor to accelerate properly, but will be very much inclined to throw over quickly to the running position. This will draw a very high current from the line, and as in this position the overload release coils of the circuit breaker are in circuit, the circuit breaker will be very liable to be tripped out. This will necessitate the re-setting of the circuit breaker and starting all over again with resultant delay and probable increased loss of property.

Slip-Ring Motor Suited For Fire Pump Duty

A large squirrel cage motor will take from 7 to 8 times full load current with the rotor stalled and full voltage applied to the motor terminals. Even with the most skillful operator, the motor, as ordinarily provided with a potential starter, will take at least four times its full load current from the line. If the operator is in a hurry he is apt to make the motor take 6 or 7 times full load current and under these conditions the circuit breaker will trip out. In order to equalize the starting surges the operator should leave the motor on the starting tap until the motor has reached 80 per cent. of full speed. This takes a comparatively long time, and the tendency is to throw the motor on the line too quickly.

The low starting torque of the squirrel cage motor is a very objectionable characteristic for fire pump service. The starting torque developed on a moderately sized fire pump squirrel cage motor with about half voltage at the motor terminals, is not over 25 or 30 per cent. of full load torque. Where such a motor is installed in a comparatively high building, the motor will possibly not be able to accelerate at all on account of the pressure head. The squirrel cage motor is therefore vastly inferior to the slip-ring motor for fire pump installations where reliability and ease of operation should be the primary considerations.

In acceleration, the latter type of motor acts similar to the shunt wound direct current motor, and while the results in starting are not equal to the compound wound direct current type the starting torque is sufficiently high to allow the motor to be accelerated quickly and easily without taking a heavy current from the line, and therefore without danger of tripping the circuit breaker. The slip-ring motor is consequently better than the squirrel cage type for fire pump duty.

The controller for the fire pump motor must be simple in design, easy to operate and reliable. The Cutler-Hammer Manufacturing Company, of Milwaukee, have recently put a new type motor driven alternating current fire pump controller on the market. The one shown in the illustration is for a 100 h.p., 440 volts, 3-phase, 60-cycles slip-ring motor. Mounted on the control panel are a voltmeter, an ammeter, a three-pole rigid arm plain overload circuit breaker, a three-pole double-throw knife switch, a pressure governor and a combined manual and automatic fire pump motor starter. At the back of the panel in a suitable angle iron frame are mounted the cast iron resistance grids which are used as the

starting resistance in the secondary circuit of the motor. The whole controller is enclosed in a sheet iron splash proof case mounted on a pedestal two feet high.

The double-throw knife switch is for transferring the motor from one set of service lines to another, as connection to two separate power lines is often provided for reliability. The starter proper consists of a square shaft above which are mounted the three primary and the six secondary cam operated switches. There is also an auxiliary cam operated switch at the extreme right, the function of which is described below. The cam shaft, which actuates these switches is revolved for manual operation by a hand lever shown at the extreme left of the shaft.

Manual Operation Important

The manual operation is of primal importance and it is only necessary for the operator (who may be an inexperienced night watchman) to pull the hand lever from the upper position through 180 degrees to the lower or full running position. The lever is held in the running position by an automatic release coil. The movement of the lever above described first closes the three primary switches simultaneously and then closes the secondary resistance switches in proper succession, until the motor is brought up to full speed. The secondary switches are so designed that the resistance is cut out of each phase at the same time in equal portions and thus the motor is kept balanced all during the starting period. On failure of voltage or at the will of the operator the switches are all opened, the shaft being returned by a heavy clock spring.

Need For Automatic Control Also

If automatic control can be conveniently incorporated without complication of the hand operation, it gives a satisfactory method for maintaining a constant water pressure when a single sprinkler head opens or when a leak develops in the piping system. Furthermore the automatic operation provides a safety feature which is not available in a straight hand starter. Watchmen are prone to leave the building or the section of the building where the controller is installed and in case of fire the automatic control feature is a decided advantage as it puts the pump in operation and keeps the pressure up to maintain a sufficient water supply.

As in the hand operation, the cam shaft is revolved to start the motor, but the operation in this case is taken care of automatically by a pilot motor mounted on a bracket below the right hand portion of the shaft. This motor drives the shaft through a worm gear reduction box, the gears running in oil. A solenoid operated clutch is between the reduction gear box and the cam shaft. The automatic starting operation is as follows: when the pressure in the tank or stand pipe falls below a predetermined amount, due to opening of sprinkler heads, leads, etc., the pressure governor closes the control circuit for a small two-pole magnetic switch located just above the cam shaft at the right hand end. This switch closes and opens the pilot motor circuit. At the same time the governor closes the clutch solenoid circuit. The pilot motor revolves and a spring behind the movable jaw clutch member is compressed by the clutch solenoid. As soon as the jaws match, the spring causes the clutch to engage and the cam shaft is revolved. The three primary switches are closed quickly due to the shape of their cams. The secondary switches are then closed in succession, cutting resistance out of the motor rotor circuit just as in the case of hand operation. After the last secondary switch is closed the auxiliary cam switch opens and drops out the pilot motor switch, thus stopping the pilot motor and preventing further revolution of the cam shaft. The worm gear reduction prevents the motor revolving backwards, and keeps the switches in the running position with the fire pump motor up to speed.

The clutch solenoid remains in until the pressure in the sprinkler system reaches the required maximum, when the pressure governor opens the circuit to the clutch solenoid, disengaging the clutch. The heavy clock spring returns the cam shaft quickly to the "off" position. The clutch solenoid is therefore the automatic and the no-voltage release, because the solenoid when de-energized allows the starter to return to the off position, stopping the motor.

The entire controller is built to meet the most rigid fire pump requirements. There is no iron to iron bearings and all parts are designed to withstand the effects of periods of idleness in damp locations. A fire pump controller must be ready to start on a moments notice even though it may have been idle for a month or more. The particular feature of this fire pump controller is its adaptability to either hand or automatic operation without any mechanical change.

Hysteresis Starting Resistance

By Mr. C. C. Clark

The hysteresis starter is specially adapted for use in connection with slipring type induction motors driving machine tools, hoists, cranes, elevators, etc., and in all cases where a large starting torque is required, and where a motor is required to start, stop and reverse very frequently. The construction and operation of the starter are extremely simple and there are no moving parts to wear or get out of order.

The starter consists essentially of three laminated cores placed one on the other as shown in Fig. 1. On each core

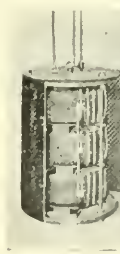


Fig. 1.

is wound a coil of wire. The three coils are connected in star. A diagram of connections is shown in Fig. 2.

The operation of the starter is quite automatic and the torque obtained from the motor at starting can be varied by changing the neutral point on the winding of the starter so that the correct amount of current will pass to produce the desired torque. The torque may in this way be varied through a considerable range. The starter is always left permanently connected to the slip-rings of the motor, and the motor is started by simply closing the primary switch. The moment the switch is closed the motor rotor will be standing still; consequently the frequency in the primary and secondary circuits will be the same and the reactance in the starter will be at the maximum value. As the speed of the motor increases, the secondary frequency and reactance in the starter decrease until the motor reaches nearly synchronous speed when it will be at the minimum value. Under these conditions constant torque is obtained during the starting period and by the use of steel of a special nature with high hysteresis losses, a high power-factor is obtained. The great advantage of this type of starter is,

therefore, simplicity in construction, which is especially desirable for heavy service. There are no moving parts or contacts to burn. A large starting torque can be obtained, from $2\frac{1}{2}$ to 3 times normal torque, and the starter is practically indestructible.

The following is an example of the method used in the design of this apparatus. In the first place it is necessary to know the characteristics of the steel being used. The saturation curve of a suitable steel is shown in Fig. 3, also the power-factor curve. In the figure, B represents the flux density per sq. cm. From this curve it can be seen that the highest power-factor is obtained by working the steel at a density of about 12,000 per sq. cm. Using this value would, however, make the starter too expensive and it is necessary, therefore, to raise the density to 15,000 per sq. cm., which reduces the power-factor from 0.67 to 0.6. The starter must be designed to suit the motor it is to be used in connection with in order to obtain the best results, and to do this it is advisable to calculate two or three designs using a sufficient number of turns for each. For example, take a starter for an 8 h.p. motor. Assume the cross-sectional area of the steel to be 66.8 sq. cm. and the length of magnetic circuit 77 cm. and the number of turns for these designs 29, 20 and 11,

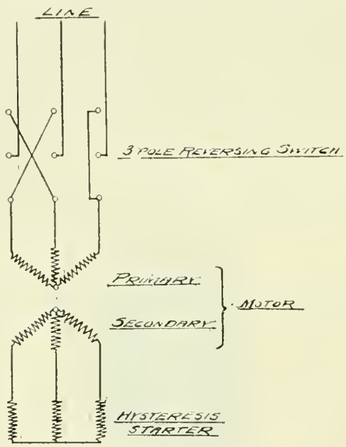


Fig. 2.

respectively. The voltage curve can be calculated from the formula:—

$$E = 4.44 \times N \times f \times d \times B \times 10^{8}$$

Where E is volts per phase; N, number of turns; f, frequency; d, area of total core in sq. cm.; B, intensity of magnetic field.

If we use 29 turns per phase and a frequency of 60 the results work out as follows:—

B	E	Amp. turns per c m	Amp. turns per ring	Amp.	P. F
4000	17.2	9.8	755	26	0.54
8000	34.4	13.2	1048	36.2	0.65
12000	51.6	17.8	1375	47.3	0.67
15000	64.4	23	1775	61	0.61
18000	77.3	33.8	2610	89.8	0.44

In the same way the results can be obtained using 11 and 20 turns respectively, see curves Fig. 4.

The calculations are made assuming that the motor rotor is at a standstill and the torque is figured accordingly. There is one point in each curve at which the motor will work to the best advantage. This point may be determined by marking off the open circuit voltage on the vertical scale and the rotor short circuit current on the horizontal scale. Join these two points by a straight line and the point where the line intersects the saturation curve shows where the starter will work to the best advantage with the motor for each respective number of turns on the winding, see Fig.

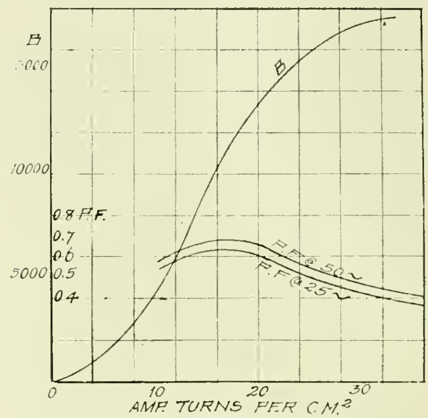


Fig. 3.

4. The best value for the secondary voltage of the motor is given by the formula:

$$E = \frac{\text{Primary volts}}{\text{ratio of turns} \times 1.04} \text{ where}$$

$$\text{Ratio of turns} = \frac{\text{prim. slots} \times \text{wires per slot}}{\text{sec. slots} \times \text{wires per slot}}$$

Assuming that the primary and secondary are connected in the same manner, the secondary short circuit current is given by the formula:

$I_1 = I_2 \times$ ratio of turns $\times$ 1.09

Where I_1 = secondary short circuit current

and I_2 = primary short circuit current.

Now the torque is proportional to the losses in the sec-

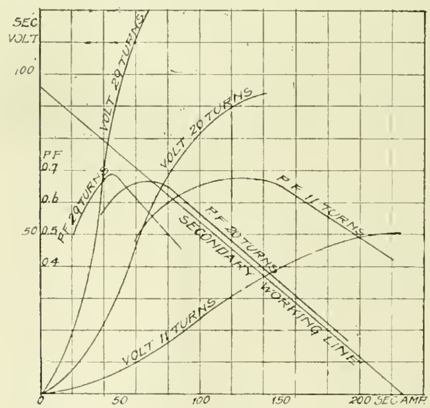


Fig. 4.

ondary circuit which are equal to the sum of the losses in the rheostat and the copper losses in the secondary winding. Therefore torque in horse power is given by the formula,—

$$\text{h.p.} = \frac{E_3 \times I_3 \times \sqrt{3} \cos\phi \times I_3^2 R}{746}$$

Where E_3 and I_3 are the voltage and current at the point

of intersection (Fig. 4) and R equals total secondary resistance of rotor and cos ϕ is the power-factor.

In the example above $E_2 = 87$, 65 and 37.5, $I_2 = 42$, 73 and 138; $R = 0.15$ and h.p. is, therefore, equal to 5.5, 8.5 and 11.9 respectively. From this, it is seen that the h.p. increases to a certain point as the number of turns decreases. If curves are plotted showing hysteresis, horse power, and copper losses as in Fig. 5, assuming the working power-factor is 0.65, the hysteresis losses are at a maximum value at half the short circuit current and half the secondary voltage but the copper losses are increasing all the time.

From Fig. 5 it can be seen that the total h.p. reaches its maximum at about 3/4 of the rotor short circuit current.

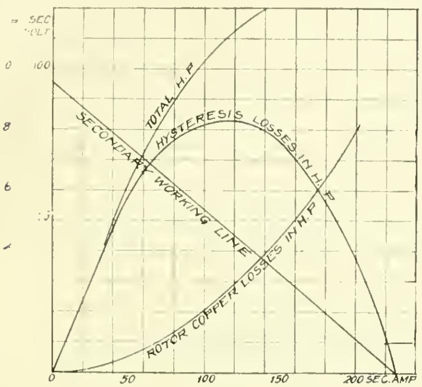


Fig.5.

The best working value is, therefore, with about half the short circuit current in the rotor or perhaps 20 per cent. above this amount.

The primary starting current is approximately:—

$$I = \frac{I_2}{\text{ratio of turns} \times 1.09} + I_0$$

Where I_0 = the no-load current of the motor.

From the above formulae it can be seen that the motor should be designed so that:

$E_1/2 \times I_1/2 \times \sqrt{3} \times 0.67 \times 1/746$ is equal to the torque required in h.p. Using primary values the torque in

$$\text{h.p.} = \frac{E_2 \times I_2 \times \sqrt{3} \times 0.67}{4 \times 746}$$

The motor must be designed for a short circuit current of

$$I_2 = \frac{\text{starting h.p.} \times 746 \times 4}{E_2 \times \sqrt{3} \times 0.67}$$

If the motor is designed for the short circuit given by the above formula, the rheostat can be easily adjusted, so that the motor, on starting, has half the secondary voltage and half the secondary short circuit current in the rotor. The hysteresis losses increase in proportion to the frequency. More steel is, therefore, necessary for a 25 cycle starter than for a 60 cycle starter.

The patent for this type of starter is held by the General Electric Company of Sweden.

The Montreal Tramways Company have ordered from the Canadian General Electric Company two 1,000 kw. motor-generator sets. One set is to be installed in the Cote des Neiges station of the Montreal Public Service Corporation, and the other in the St. Henry sub-station of the Tramways Company. The power for these machines will be delivered to the stations by the Montreal Public Service Corporation.

Exhibits at the Canadian National

Along with other departments of Canada's great national annual Exhibition, the electrical display continues to grow in magnitude and interest. This is especially true with respect to illumination fixtures, and heating and household appliances. The variety of fixtures this year is very great, and their designs probably more beautiful than ever, though possibly the most noticeable advance is shown in the varied appliances of electricity for the home, including not only irons, toasters, etc., but efficient heating and cooking appliances, sweepers, washing-machines, etc., applications which have been more tardy in arriving but which will mean more to the house-wife, in proportion as they relieve her of the heavier duties of household labor.

There is no doubt however that the electrical exhibit still fails to create as favorable an impression as its magnitude and the variety of the equipment shown should demand, on account of the scattered location of the various booths. Compare for example the satisfaction one gets in visiting the automobile exhibit, as compared with what it would be if these were scattered in all of the different buildings, so that one would stumble across certain manufactures only by the merest chance. The exhibit of electrical appliances will never receive its proper attention, or carry its full value, until a special building is set aside for electrical equipment alone. There is no question but that this building to the vast majority of visitors could be made the most attractive on the grounds.

Among this year's exhibitors, of special interest to electrical men, may be mentioned the following:—

Chadwick Brass Company—Supplemented their exhibit of decorative brass-ware with a number of handsome electric fixtures.

Lumen Bearing Company—Had a display of babbit metals; also a new type of car wheel for electric railways, that they have just placed on the market.

Keiths, Limited—Their exhibit consisted largely of electrical fixtures. It was one of the most attractive exhibits of the kind at the fair.

James Morrison Brass Company—Had a varied exhibit of electric fixtures this year as usual. This branch of their business is in charge of Mr. Frank Morrison who has a nation-wide reputation as a producer of original and attractive fixture designs.

The Jones & Moore Electric Company—This exhibit consisted chiefly of a large number of motors in varied sizes. An interesting side-line was their display of Pelouse electric irons, which attracted much attention.

The Stromberg-Carlson Telephone Manufacturing Company—Showed a complete line of telephone apparatus, including automatic key type inter-comm-phone equipment, for use in offices, factories, residences and public buildings; telephones for despatching systems on both electrical and steam railways, mine-a-phones, signal bells, magneto telephones and switchboards for rural line and central energy exchange systems.

The Norton Telephone Company—In addition to the varied telephone equipments shown, a number of lighting fixture and tungsten lamps were also exhibited.

The Canadian Carbon Company—In the transportation building had an interesting display of X-Cell dry batteries, carbon products and electric sundries. A feature of their display was a battery shown in operation under water.

The Toronto Hydro-Electric System—The outstanding feature here was probably the very attractive kitchen shown, in which the many uses to which electrical equipment can be put were attractively demonstrated. In another room a splen-

did display of this equipment was shown, including radiators, stoves, washing-machines, suction-cleaners, etc.

The Holophane Company—No special booth was set aside for this company, but their products were seen, to advantage, in the illumination fixtures of the Toronto Hydro-Electric System and the Toronto Electric Light Company.

The Toronto Electric Light Company—The most interesting feature in this exhibit was the electric dining-room, where the products of electric cooking were so enticingly displayed, that this booth was constantly the centre of attraction. Two other rooms equipped by this company, showed many other household appliances in operation.

R. A. Lister & Company—This firm specializes in gas engines and small electric generating plants. A number of engines were shown in operation, also two small electric plants, suitable for farm use or for large country homes or hotels. A large number of these plants have been installed at different points in Canada.

International Agencies—Showed a varied exhibit of raw and manufactured aluminium.

The Colonial Fixtures, Limited—Showed a varied display of handsome fixtures, in which the colonial design was the most prominent feature.

William Hamilton Company—This company, among other things, exhibited one of their improved Samson water turbines. A card was also distributed giving the wonderful results recently obtained in a Holyoke test, which showed that one of these turbines, operating at an approximate head of 17 ft. at approximately 185 revolutions per minute, had an efficiency, between full gate and half gate, varying from 82 per cent. up to 90 per cent., the highest efficiency being at three-quarter gate.

Airozone Electric Ventilating Company—This firm exhibited their Ozone generating equipment, and distributed literature explaining the value of Ozone as an air purifier in offices, schools, private homes, etc.

The Canadian Independent Telephone Company—The most interesting feature in connection with the exhibit of this company, was the working model of a twenty-five line "presto-phone" switch-board. This board is specially designed for large offices, warehouses, etc. It is of the automatic type of operation, and probably represents the highest degree of cleverness in design and care in construction that the telephone world has seen.

Jones & Glassco—This firm are the sole agents for Canada, for the Hans Renold, Limited, Manchester, and the exhibit consisted chiefly of a working exhibit of a Renold silent chain.

National Electric Heating Company—A special exhibit of irons, toasters, etc., was shown; also an efficient line of heaters and radiators. As indicating the advances being made in electric heating, this firm will shortly install its heating equipment in a Toronto apartment house, where no other source of heating will be obtainable.

The British Aluminium Company—This attractive exhibit indicated the great variety of use to which aluminium is now put. One interesting example shown of its use was a section of the field winding of a motor, which indicated both compactness in design and light weight.

The Macey Sign Company—Exhibited their "American Lens" electric signs, which is said to save 80 per cent. by its efficiency. It is also claimed that these signs can be read three times as far as the ordinary all-lamp type of electric signs.

W. H. Banfield & Sons—Had a very complete display of chandelier chains, in many handsome designs. A number of fixtures were also shown.

The Automatic Electric Cook Company—Exhibited their automatically operated electric stoves and ranges. The automatic control of current used in this equipment is very complete, being such that the temperature can be regulated within a limit of two or three degrees, for an indefinite period.

The Canadian Fairbanks-Morse Company, Limited—Their exhibit of gasoline engines, transmission machinery and mill supplies gave an idea of the large and varied number of lines handled by this firm.

The Tallman Brass & Metal Company—This is one of Hamilton's oldest established industries. For many years they have been large manufacturers of babbit metals. They have just increased their plant for the extensive manufacture of electric fixtures. Their exhibit of fixtures at the fair was in every way worthy of the firm.

The Canada Sanax Company—Exhibited a quantity of medical equipment, prominent among which were the well-known Foen electric hot and cold air producers. Other equipments included an electrically driven vibrator, X-Ray apparatus, etc., etc.

The Crown Electric Manufacturing Company—Had an artistically arranged booth given over entirely to electrical fixtures of very beautiful design.

The Northern Electric & Manufacturing Company—Showed a varied assortment of fire alarm systems, also telephones and telephone accessories and general electric supplies.

McDonald & Willson's exhibit of electric fixtures was the centre of continual interet.

Hot Point Electric Heating Company showed a varied assortment of electric irons, toasters, heaters, etc.

Faircloth & Company had a beautiful exhibit of colored glass-ware and electric fixtures.

Radiant Electric Company—Exhibited a complete line of household equipment and luxuries, including irons, toasters, heaters, foot-warmers, radiators, etc.

Isolated Plant for Halifax

The Acadia Sugar Refining Company, Halifax, N.S., are at present installing a private generating plant including equipment as follows:—3 750-kw. bleeder type turbo-generator units, the electrical characteristics being 3-phase, 600 volts, 7200 alternations, 3600 r.p.m.; 1 11-panel switchboard for the control of the three 750-kw. turbo-generators, exciters, feeders, etc.; and 45 alternating current 60 cycle motors having aggregate horse power of 700.

The above equipment is being supplied by the Canadian Westinghouse Company. Forty-one motors ranging in capacity from 185 h.p. down are also being supplied by the Siemens Company of Canada.

A. G. Marshall, of Ottawa, has been given the contract by the Public Works Department for installing the underground services for the Parliament Buildings, Ottawa, which include the East and West blocks and the Supreme Court. The contract price is $11,995. The specifications of the contract were given in the last issue of the Electrical News. The work is to be rushed to completion without delay.

The Maritime Coal, Railway & Power Company, Limited, recently awarded a contract for a reinforced concrete dam of the Ambursen type to the Ambursen Hydraulic Construction Company, Limited, of Montreal. The dam will be 200 feet long and is to be used for storing water on the Chignecto creek. The storage of water created by this dam is to be used as a condensing pond for the steam generating plant of the company. The steam and electrical equipments being installed at the present time will give more than double the capacity of the original installation. M. A. Sammett of Montreal, is the consulting engineer of the company.

Selt-Propelled Railway Passenger Cars

Rapid Development of the Internal-Combustion Type with Both Mechanical and Electrical Transmission

By Mr. S. T. Dodd*

The history of the self-propelled railway passenger cars extends over the last sixty or seventy-five years; indeed from the time the first steam locomotive was developed the thoughts of inventors have turned toward the development of a car in which the motive power and seating compartment would be united in one unit; and experimenters have advocated, and built, a number of different types of such cars.

Steam, compressed air, electric motors driven by storage batteries, and internal combustion engines, have all been advocated as the motive power. Without going into the details of the many different experimental cars built, and the advantages of different types of motive power, we can say that at the present time the advantages of the internal combustion engine in operation, maintenance, and radius of operation are so marked that this article will confine itself wholly to a discussion of the railway passenger car driven by internal combustion engines and a study of its characteristics, maintenance, and cost of operation.

Internal combustion engines have been built which will use fuel in any of its three forms, solid, gaseous or liquid. The use of solid fuel, however, has not as yet been successful, and gas fuels while eminently satisfactory in certain cases are practically prohibited by the conditions of motor car operation. The gas must either be carried compressed in tanks, or manufactured for immediate use in gas producers on the car. These methods, however, limit the operating radius of the car or introduce the same complications which have prevented the success of the steam car and compressed air car.

The use of liquid fuel avoids these limitations. Internal combustion engines using this form of fuel are well known and have proved satisfactory, having reached a high degree of perfection. Liquid fuel offers many advantages in methods of storage and handling, and can be obtained with a much greater heat value, weight for weight, than any other form.

As an illustration of the economy of this type of fuel, it is to be noted that gasoline cars of from 35 to 50 tons in weight, in actual operation in steam line service, are carrying an amount of fuel which is equivalent to a radius of operation of 300 miles, without recharging; and that, including the weight of water for cooling the cylinders, the total weight of fuel and cooling medium does not exceed 2,750 pounds.

As the popularity of the internal combustion engine has been due to gasoline and naphtha, it is to these one naturally resorts for motor cars, and as a consequence, the car we have under consideration is popularly known as the gasoline car. From a historical standpoint the successful application of this type dates from the modern development of the gasoline engine, and is, therefore, comparatively recent. The discussion can consequently be limited to a very few successful types and these can more conveniently be discussed in two groups divided according to the method of transmission of power from the engine to the axle.

(a) Gasoline cars with mechanical transmission to the axle. These will be referred to as mechanical-drive gasoline cars.

(b) Gasoline cars with electric transmission from engine to axle, referred to as electric-drive gasoline cars.

Mechanical Drive

The application of the gasoline engine to light cars for inspection and emergency service is outside of the limits of this discussion and aside from these the best known development for passenger service has been the type of car built by the McKeen Motor Car Company, or the so called "McKeen Car." The development of this car began in the shops of the Union Pacific R.R. Co., at Omaha, under Mr. W. R. McKeen, Jr., at that time Superintendent of Motive Power of the Union Pacific. The construction of the cars was afterwards transferred to a separate organization which was formed to undertake this work and which became known as the McKeen Motor Car Company. The first of these cars was built in 1905. In its latest development, the standard car consists of a steel body 70 feet in length with center entrance or side doors. In this car the designer has made the side of the car assist the floor beams in strengthening and stiffening the whole structure, making of the car floor and sides a composite girder, while the shape and location of windows and doors are subordinated to the requirements of strength. The exterior of the car, having smooth sides, pointed ends, and a sloping roof, gives the general impression of being suitable for high speed service. The interior of the car is divided into an engine compartment and a seating compartment, either with or without smoker, baggage, or express compartments. The passenger compartment may seat as many as 100 passengers.

The car is carried on double trucks, of which the rear is a four-wheel steel frame trailer truck with 33 in. wheels, and the forward truck under the engine room is a motor truck. This motor truck has one driving axle with wheels 42 in. in diameter to which the power is transmitted from the engine. The gasoline engine which stands on this truck, and swivels with it, is a six-cylinder engine with 10 in. by 12 in. cylinders driving a crank shaft at right angles to the center line of the car. A sprocket is carried on this crank shaft which drives the forward axle through a chain drive by means of an air operated friction clutch. Two gear ratios are supplied and the air clutch throws in the one or the other of these sets of gears, thus obtaining a slow speed and heavy tractive effort for starting, or a high speed for running. With either one of these gear ratios, the variation in speed from minimum to maximum is attained entirely by variation in engine speed regulated by the throttle and spark. With low speed gearing the full engine power is ordinarily attained at about 10 to 15 m.p.h., while with the high speed gearing the full engine power is attained at the maximum running speed of the car. Maximum speeds developed by these cars are reported as high as 60-70 m.p.h. The cars are fitted with fuel tanks of 100 gallons capacity and weigh complete approximately 35 tons.

The manufacturers report that in April, 1913, one hundred and thirty-eight of these cars were in service on fifty different railroads in the United States and foreign countries. The following are some of the typical railroads operating McKeen cars in various parts of the United States: Santa Fe; Buffalo, Rochester & Pittsburg R. R.; Ann Arbor; Virginia & Truckee; Union Pacific; Texas City Terminal; Woodstock & Sycamore Traction Company; Charles

* Railway Engineering and Traction Department, G. E. Co.

City & Western Railway. Norfolk & Southern; Chicago & North-Western; Erie Railroad; Pennsylvania Railroad; Riviera Beach & Western.

In addition to the McKeen cars, some other mechanical-drive passenger cars might be mentioned, although they are less widely in use. Among others the Fairbanks-Morse Company, of Chicago, has built a mechanical-drive gasoline car with single trucks, steel body, and seating capacity of 21 passengers. The P. H. Batten Co., of Chicago, has also built cars of this type with a seating capacity of about 30 passengers, which are in operation on three roads in the Central West. The Stover Motor Car Co., of Freeport, Ill., has supplied small single-truck gasoline cars on the Waterloo, Cedar Falls & Northern Railway, and upon the Chicago, Rock Island & Pacific R. R. The Hall-Scott Motor Co., of Oakland, Cal., has built double-truck cars with a seating capacity of 50, and a 100-h.p., four-cylinder engine driving the rear axle through longitudinal transmission and double gears.

In Europe mechanical-drive gasoline cars have been built by several companies, and either are or have been in use on the Great Northern Railroad (England), the Swiss Federal Railroads, and the Wurtemburg State Railways.

Electric Drive

The fundamental difference between these cars and those discussed in the preceding section is that the engine drives an electric generator, and power is transmitted electrically to motors, geared to the driving axles, instead of the engine being connected directly to the axle by mechanical gearing.

Of this type of car, the most extensive experience has been obtained in this country with the car manufactured by the General Electric Company, which began its design of gas-electric cars several years ago, with the construction of a car for the D. & H. R. R. This car was a standard steam railroad coach, built by the Barney & Smith Car Company, with trucks built by the American Locomotive Company.

The gasoline engine for this car was purchased in England, as at that time there were no suitable engines built in this country to meet motor car requirements. The details of electrical equipment were proportioned upon results of previous experience with heavy railway equipments. After a service of several months covering operation in commercial service of about 5,000 miles, a second car was built, in which the entire equipment was furnished by the General Electric Company, and the design and characteristics were based upon their experience with the first car. The result of this experimental service has been to develop a standard type of gas-electric car which has met with very favorable reception for interurban and branch line service, and to which the following general description applies.

The car body is built of steel and is designed for the combination of the greatest lightness and strength. The front end of the car is rounded to reduce train resistance to a minimum when operating at high speeds. Either center or rear entrance are supplied to meet the requirements of traffic in various localities. The cars are built in lengths running from 40 ft. to 70 ft. overall and weighing from 40 to 50 tons complete. The interior of the car is subdivided into passenger, smoker or second-class, baggage, and engine room. The width of the car is 10 ft. over all, full advantage having been taken of standard steam railroad clearances, and the cars have a seating capacity which may run as high as 95 or 100 passengers per car, depending upon the interior arrangement.

The power plant is located in the engine room at the front end of the car and consists of an eight-cylinder, 550 r.p.m., four-cycle gas engine of the V-type, direct connected to a 100 kw., d.c. generator. The generator is built essentially to meet motor car service and is, therefore, designed to carry a wide range of output in current or voltage, so that the output may be varied from 400 amperes at 250 volts to 125 amperes at 800 volts.

The trucks are of an equalized, swing-bolster type, suitable for the high speeds obtainable with this type of car. One of these trucks is a motor truck, designed for carrying two driving motors. The other is a standard light trailer truck. The motor truck is generally placed under the forward end of the car and carries the weight of the engine room equipment in addition to the motors. In such a case as this, about sixty per cent. of the weight of the car is on the driving wheels. In some cases, however, the motor truck has been placed at the rear end of the car, under the passenger compartment, and in this case, approximately fifty per cent. of the weight of the car is on the drivers.

The car is equipped with two GE-205 100-h.p. railway motors. This is a commutating pole motor and is suited for wide variation in operating voltage. The gearing is specially selected for the service. The gear ratio is low enough that the highest maximum car speed will not develop excessive rotative speed of the armatures; at the same time the ratio is high enough to obtain the requisite starting effort without imposing excessive overloads on the motors.

The car is designed for operation from one end only. The engineer's seat is located at the right hand front window of the engine room, and controller and throttle handles are placed directly in front of him. The controller is a convenient combination of engine and generator control, with the different levers placed vertically above each other and operating about practically the same center line. The highest of these levers is the throttle lever, which controls the supply of gasoline to the engine, and as a consequence the speed and power of the engine. Directly beneath this is the electric control handle. On the first part of the range of this handle the two motors are connected in series, and the whole current of the generator passes through each of them. Successive steps raise the generator voltage from about 250 volts on the first step to about 700 volts on the seventh step. In passing to the next step of the controller, the voltage is reduced to about 250 volts, and at the same time the connection between the motors is changed, putting them in multiple with each other. On the remaining steps the two motors are running in multiple, dividing the generator current between them and each actuated by the full generator voltage. This voltage is raised in successive steps up to a maximum of about 800 volts on the thirteenth step. Two final steps, in addition to this, are suitable for particularly high speeds on level track with shunted motor fields.

The engine generator set is started by admitting compressed air to the cylinders. This is done automatically on the first opening of the throttle. As soon as the engine turns over, and the first charge of gasoline is exploded in the cylinder, the air is automatically shut off.

Air reservoirs are charged and air for the brakes, whistle, and for starting the engine is furnished from an air compressor driven from the main crank shaft of the engine. A small independent engine generator set is supplied for furnishing the lights and a separate compressor connected to this engine is used for charging the reservoirs in case they are entirely empty.

This type of car has demonstrated very marked advantages, and is in operation on a number of steam railroads in various parts of the ocuntry. At the present time 60 of these cars are in regular daily service and some of the roads on which they are in use are shown in the following table.

	Number of Cars in service
Southern Railway	2
Frisco Lines	16

Minn., St. Paul, Rochester & Dubuque Electric Traction Co. (Dan Patch Line)..	12
Bangor & Aroostook R.R.	2
Quanah, Acme & Pacific Ry.	1
Missouri & No. Arkansas R.R.	2
Texas Midland R.R.	2
Rock Island Lines	2
Pittsburgh & Lake Erie R.R. ..	1
Great Northern Railway	2
Chicago, Mil. & St. Paul Ry	7
Chicago, Peoria & St. Louis ..	4
Santa Fe	2

In Europe the most extensive experience with electric-drive gasoline cars has been on the Arad-Csanad Ry. in Hungary. This road has been operating gasoline cars since 1905. At the present time they are running approximately 1,000,000 car-miles per annum and have a total record of over 5,000,000 car miles with these cars. Their records of cost of operation and maintenance on such equiments are probably more complete and extensive than any other railroad, and show an average cost of maintenance of 2.5 to 3 cents per car mile. These cars were built by the French Westinghouse Company and recently the same type of car has been introduced into this country, in the car known as the "Dracar," built by the Drake Railway Automotrice Company, of Chicago. This company has already furnished five of these cars for the Missouri-Oklahoma & Gulf Railway Company, and reports orders in hand for a number of other cars. The "Dracar" is 56 ft. long over bumpers and 9 ft. 6 in. in width. The car is divided into first-class, second-class, engine and baggage room compartments, and the general scheme of control and utilization of electrical energy is substantially the same as previously described in connection with the General Electric car.

A few remarks might be in place in this connection upon a type of car which has been tried to some extent and which still seems to find some advocates, that is, the combination of the gasoline-electric car with a storage battery auxiliary. The idea of storing up electricity in a storage battery appears to be so feasible, that the writer finds an insistent inquiry among some engineers for this type of car.

Storage Battery of No Real Value

The fact is that the storage battery is of no real value in combination with the electric drive as it has been developed to-day, and as we have described it above. The real value of the electric drive lies in the possibility of working through a wide range of voltage and current, and the idea of using the storage battery in connection with it is based upon a misconception of the meaning and advantages of the electric drive and is derived from experience with constant potential control. To illustrate, with a self-propelled car having an independent gas-electric drive, if we were forced to keep constant voltage on the generator and, having constant horse-power from the engine, were forced to maintain a constant output of current, it would be absolutely necessary to furnish a storage battery auxiliary. This storage battery would provide the increased current necessary at starting and would absorb the surplus power when running under light conditions. But these are not the conditions which we have with the electric drive as developed to-day. We are not limited to a fixed current from the generator, as the electric generator has the same overload capacity in current as the driving motors. The only fundamental limitation is the horse-power of the engine, and by varying the generator voltage it is possible to obtain the full engine horse-power throughout the whole range of operation, from slow speed and high tractive effort at starting to high speed and low tractive effort at full speed running conditions. Keeping this in mind, it is evident that with the variable voltage control it is possible to obtain the same results from the electric drive alone that would be obtained from constant potential control with the addition of a storage battery. In addition to this, a storage battery has an efficiency of only 40 to 60 per cent. and this loss is entirely eliminated by leaving the battery out. As far as weight is concerned, the same weight of material which would give a kilowatt of continuous capacity in the form of gas engine and generator would only give a kilowatt for one hour if installed in the form of a storage battery. It appears from these facts that with variable voltage control the gas-electric drive gives the same **results as the storage battery auxiliary and with greater** economy in weight and power.

Comparative Characteristics

Now to compare the characteristics of the mechanical-drive gasoline car with the electric-drive gasoline car, the fundamental difference between them lies in the method of transmission of the power between engine and axle. The comparison of the characteristics is well illustrated in the curves of Fig. 11. These curves show the speed, tractive effort, and gasoline consumption of a car equipped with a

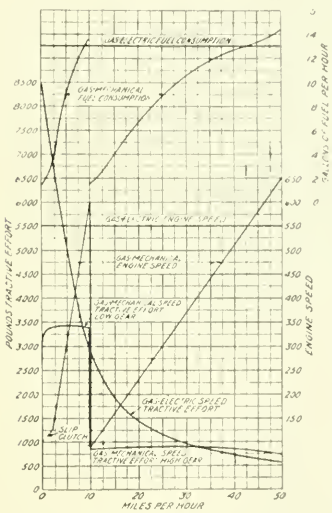


Fig. 1—Curves showing comparative characteristics of mechanical and electric drive.

100 h.p. 550 r.p.m. gasoline engine, driving in the one case, through electrical transmission, the motors geared to 33 in. driving wheels, and in the other case, through mechanical transmission, a single pair of driving wheels 42 in. in diameter. The slow speed gear reduction has been assumed at 7.5 to 1 and the high speed gearing at 1.6 to 1. These conditions correspond approximately to those ordinarily obtained on mechanical-drive gasoline cars of this weight and capacity. The following characteristics can be noted by reference to the curves:

(1) **Engine Speed**—In the electric-drive car the engine speed is independent of the car speed and is maintained at the normal value 550 r.p.m. throughout the whole range of car speed. In the mechanical drive car the engine speed is proportional to the car speed. It starts at a low value with the starting of the car, and increases with the car speed up to 600 revolutions at a car speed of 10 m.p.h. At this point the change gear clutch is thrown in, the engine speed is cut down to 100 r.p.m., with the higher gearing, and is again

raised with the car speed to 650 r.p.m. at a car speed of 50 m.p.h.

(2) **Engine Horse Power**—This is approximately proportional to the engine speed. With the electric drive the horse power is maintained at 100 h.p. throughout the range of car speed, but with the mechanical drive the horse power varies, reaching its maximum value at the maximum speed corresponding to the two gear ratios.

(3) **Tractive Effort at Wheel Rim**—The electric drive, on account of its constant horse power output, develops a tractive effort which varies inversely with the speed. It reaches a maximum of 8,500 pounds at slow speeds, and falls off with increasing speeds at such a rate that at any point the product of speed and tractive effort are constant. The mechanical drive develops a maximum tractive effort of 3,400 pounds up to a car speed of 10 m.p.h. At this point, where the high speed gearing is thrown in, the tractive effort drops to 900 pounds, which is maintained approximately constant through the further range of car speed.

The speed-torque characteristics of the electric drive is very similar to that of the steam locomotive. The maximum tractive effort is limited by the slipping point of the wheels, or by the maximum current which the generator can drive through the motors with the full engine output. That is to say, the current at which the total horse-power of the engine is used up in heating of the motor and wiring will be the limiting current, and the corresponding tractive effort will be the maximum obtainable. General Electric gas-electric cars will in practice develop a maximum tractive effort of 10,000 to 14,000 pounds, depending on the gearing.

(4) **Fuel Consumption**—In the electric drive the fuel consumption is constant, on account of the constant horsepower output. In the mechanical drive the fuel consumption varies with the output of the engine, and, therefore, with the speed of the car, except for the varying efficiency of the engine at different speeds.

Advantages of Electric Drive

The electrical transmission from engine to axle is apparently an added complication, but a number of advantages are claimed for it which largely offset the apparent complication.

These advantages may be briefly stated as follows:—1. Superior control; 2. Greater reliability; 3. Lower cost of maintenance.

(1) The control is superior to clutches and change gears for the following reasons:

Electric drive is equivalent to an infinite number of speed relations between the engine and car wheels without any change of clutches or gears.

The full engine output may be had at all car speeds.

It permits driving through two or more axles which is a considerable advantage for grade work or slippery rails.

The rigid wheel base of the driving truck may be made short, permitting the use of shorter curves at Y's and turn outs.

Starting and acceleration is made with absolute smoothness.

Accidental conditions can be met, such as hauling of an occasional trailer or the negotiating of a heavy grade, which could not be met if the maximum tractive effort of the car were rigidly fixed by the gear ratio.

The car can be reversed without stopping the engine, an advantage quickly apparent in yard work, switching, coupling, etc.

In case of failure of the brakes, the motors may be used to stop the car.

(2) It possesses greater reliability for the following reasons:

Speed changes are made without shocks to the apparatus.

The engine is mounted on springs on the car body and is not subject to hammer blows when passing over crossing frogs or switches.

It is free from dust and foreign material in the bearings and piping.

Minor defects are easily detected and adjusted before they become serious, due to the accessibility of the engine.

(3) The cost of maintenance is less because:

The apparatus is less subject to shocks, and, therefore, requires fewer renewals.

All parts of the engine are easily accessible.

The location of the apparatus permits making reliable water and gasoline connections and the placing of the radiator on the roof where it is protected from flying stones, etc.

Electric equipment has demonstrated its low cost of maintenance in railway service and the electric railway motor in particular is generally acknowledged to be the most rugged piece of apparatus in railway service.

Fuel and Lubrication

At the present time some of the light distillates of petroleum are the only fuels commercially available for such cars as we are describing. While this fuel has been referred to under the general term "gasoline" the fact is that the quality required is not as high as the product usually demanded and furnished under that name. At the present time, the manufacturer of these cars is co-operating with the refiners of petroleum in making an extensive study of the characteristics and specifications of petroleum distillates which are suitable for engines of the type used on the gas-electric car.

Besides petroleum distillates, there is to be considered the future possibility of the use of other liquid fuels, such as fuel oil or alcohol, but in the present state of development of the art none of these are commercially available.

The whole question of fuel and lubrication of internal combustion engines for motor cars is so extensive and far reaching that it must be dealt with in a separate article.

Inspection and Maintenance

A managing officer contemplating the purchase of motor cars usually asks a number of questions somewhat as follows, each of which we have answered briefly:

What kind of men are required to successfully operate motor cars?

A large percentage of the gas-electric motor cars are being operated by the locomotive engineers who formerly ran the steam locomotives which have been replaced by motor cars. No particular attainments are necessary to run motor cars other than that required for handling any other motive-power equipment.

What kind of training and examination should the men go through to properly qualify for operating motor cars?

It is desirable for railroads, when getting their first cars, to secure the service of an expert operator from the manufacturing company for a limited period, depending upon the circumstances and number of men to be qualified. The operators can best be broken in by starting them in to handle the cars as soon as possible, under the direction of such an instructor. The men, of course, should be provided with an instruction book, and the instructions should follow somewhat the following lines: The men should be made familiar with the names, functions, and location of all apparatus on the car. They should be given a brief general idea of the principles of a gas engine, electric generator, and electric motors. After this they should be given lessons in the proper manipulation of the car, how to run the car with the best fuel and oil economy, and how far the power plant can be pushed without overworking it. They should be taught to notice the forewarnings of trouble, how to locate such trouble, and how to make necessary running repairs and adjust-

ments. Special instructions should be given to the matter of carburetor adjustments and the timing of the engine.

What repair parts should be kept on hand?

It is very desirable to carry a selected list of repair parts. For an amount of between $200 and $300 per car a considerable number of small parts can be secured which will give a large return in insurance against failure. For overhaul parts it will be found that experience in the course of time will tell what it is desired for each particular company to carry, but, as a rule, it is thought that such parts can be anticipated previous to the car being laid up for classified repairs.

Operating Costs

As an illustration of some of the actual operating results obtained with gas-electric motor cars, the following statements are submitted. These figures are selected on account of the number of cars involved and the amount of mileage made.

TABLE I—FRISCO LINES

Cost of Operating Gas-Electric Passenger Motor Cars

Following is a consolidated statement for six months from July 1st, 1912, to December 31st, 1912, covering the direct cost of operation, including classified repairs made during the interval. This includes the performance of fourteen cars operating under varying grade and climatic conditions. Some of these cars were on several different runs.

Revenue motor car-miles	251,627
Revenue trailer car-miles	114,164
Total passenger car-miles	365,791
Per cent. of time trailers hauled	40.3
Gals. fuel (naphtha) used per m.c.m.	.721
Gals. fuel (naphtha) used per p.c.m.	.496

	Total cost for 6 months	Aver. Cost per motor train-mile
Wages of crews	$19,840.96	$0.0788
Fuel (naphtha)	11,857.68	.0471
Lubrication (gas engine)	1,553.28	.0062
Cleaning, supplies and misc. expenses	2,545.91	.0101
Running and shop repairs	7,769.73	.0309
	$43,567.65	$0.1731

The above includes extensive classified repairs given two cars, and all the running and shop repairs on the other cars.

Table II. shows more detailed information on the performance of six of the above cars. They were all on representative assigned runs averaging 166 revenue miles daily; four hauled trailers regularly and each carried a full, motor car, train crew. The actual revenue mileage only is shown, as no allowance is made for turning or other non-revenue mileage. The runs cover varying speeds and grades. The maximum grade, 2.3 per cent., occurs on the Bolivar-Chadwick run, where a trailer is hauled regularly. On this run there is one stretch of 2 per cent. grade for a distance of four miles.

TABLE II.—FRISCO LINES

Cost of Operating Gas-Electric Passenger Motor Cars

Following is a consolidated statement for eight months from July 1st, 1912, to February 28th, 1913, covering the direct cost (no classified repairs made during interval) of cars 2,104, 2,105, 2,106, 2,107, 2,108, 2,109 operating between Muskogee and Westville, Okla.; Dawton, Okla., and Quanah, Tex.; Sherman and Dallas, Tex.; Chadwick and Bolivar, Mo.; Kansas City and Clinton, Mo.; and Clinton and Enid, Okla.

Revenue motor car-miles	181,438
Revenue trailer car-miles	127,605
Total passenger car-miles	308,043
Per cent. of time trailers hauled	70.3%
Average working weight of motor cars	51.5 tons
Average load of motor cars (estimated)	3.5 tons
Average working weight of trailer cars	23.5 tons
Average load of trailer cars (estimated)	2.5 tons
Gross weight motor trains (average)	7.3 tons
Total gross ton-miles	13,296.28
Gallons fuel used per motor train-mile	.751
Gross ton-miles per gal. fuel	97.6

	Total cost for 8 months	Aver. cost per motor train-mile
Wages of crew	$11,417.09	$0.0791
Fuel (naphtha)	8,666.12	.0477
Lubrication (gas engine)	1,356.89	.0075
Cleaning, supplies and misc. expenses	1,586.89	.0088
Running repairs and labor	2,908.46	.0160
Running repairs and material	4,242.28	.0067
	$30,487.63	$0.1661

As an example of the performance on an interurban line with a very fast schedule, Table III. is submitted. The trailers hauled consist of a mixture of passenger, freight and work cars. The cost of heating supplies and maintenance of equipment includes also the cost of these trailers. The longest maximum grade of 1.5 per cent. is about two miles, and one stretch where the grade averages 1.37 per cent. for a distance in excess of four miles. In addition to the station stops, there are two railroad crossings at grade where all trains must stop for the conductor to go ahead and turn crossing gates. The motor cars then pull over the crossing and wait until conductor resets gates. There is also a draw bridge which is not interlocked, where all trains must stop.

TABLE III.—DAN PATCH LINE

Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Company

Cost of Operating Gas-Electric Motor Cars From January 1 to August 31, 1912

Total motor car-miles	216,498
Total trailer car-miles	75,948
Total car-miles	292,446
Per cent. of time trailers hauled	35.5%
Number of motor cars in service	8
Length of line	37.34 miles
Maximum grade	1.5%
Schedule time for express trains	1 hr. 17 min.
Average distance between stops for express trains	3.734 miles
Schedule speed m.p.h. of express trains	29.1 miles
Schedule time for local trains	1 hr. 35 min.
Average distance between flag stops for local trains	1.067 miles
Schedule speed m.p.h. of local trains	23.6
Gals. fuel used per motor train-miles	.758
Gals. fuel used per car-mile	.527

	Total cost for 1 year	Aver. cost per motor train-mile	Aver. cost per car-mile
Wages of crew	$12,056.95	$0.0557	$0.0412
Fuel (naphtha)	17,622.26	.0814	.0603
Lubrication (gas engine)	1,141.56	.0052	.0039
Journal oil	77.77	.0004	.0003
Supplies and car heating	1,389.03	.0064	.0047
Maintenance of electric equipment	1,949.84	.0090	.0067
Maintenance of cars and trucks	1,394.56	.0065	.0047
Shop expense and heating	3,507.77	.0162	.0120
	$39,139.71	$0.1808	$0.1338

The Accounting of Public Utilities

A paper presented by H. A. Robson, Public Utilities Commissioner for Manitoba, before the Eleventh Annual Meeting of the Dominion Association of Chartered Accountants

The expression "Public Utility," for present purposes, may be taken to refer to undertakings instituted to serve the public in such matters as transportation of either passengers or freight; the means of communication by telegraph or telephone; the production and furnishing of water, gas, heat, light or power.

These public needs have in the past largely been met by private corporate enterprise, but the attractive idea that the people should establish and operate for their own benefit their public service equipments has so taken hold that the field has become divided, and now frequently we find public utilities in the hands of the people's representatives, either municipal or parliamentary, in some cases being in competition with the private corporation.

No matter whether publicly or privately owned or operated, these indispensable adjuncts to modern industrial, commercial and domestic life are "public utilities," and, generally speaking, subject to the same control and regulation. Laws providing such control and regulation, and establishing public utility commissions to apply the same, are being gradually extended throughout the United States. In Canada the idea has taken root and will grow. To select for control and regulation this class of private corporation as distinguished from other mercantile institutions is quite logical, when it is considered that a public franchise, usually granted for a long term, perhaps in perpetuity, and almost invariably gratis or on favorable terms, is the foundation on which the undertaking rests. Such a franchise may mean the right to use the most valuable thoroughfares of a large city for tramway purposes, the right to dig up streets and install conduits and pipes, or to encumber highways with lines of poles and wires for purposes of communication, or for the conveying and distribution of a dangerous force. It has been said that such a franchise is but a part of the power or privilege of sovereignty allotted to a private person for the benefit of all, and only incidentally given for private emoluments. This delegation of sovereignty is even more conspicuous when the right of expropriation of private property is given, as to many utilities, and always to through railroads is indispensable. Such is the unquestionable justification of the control and regulation of franchise corporations; and when the questions are put: "Why should any private corporation be required to render accounts to a public authority?" "Why should the private corporation be required to follow a system prescribed by such authority?" the palpable answer is that the sovereign people are entitled to demand that it shall be disclosed, to authority established for the purpose, what benefits are resulting from the delegation of the public franchise to private interests.

Commissioner Maltbie, of the New York Public Service Commission, in dealing with the subject officially, said:—

"It has been urged by some that the public, the consumer, the taxpayer, the citizen and the public official, is not entitled to prescribe accounting systems for corporations or to know about its financial affairs. The theory has been exploded, and it is sufficient to recall the facts that public service corporations have been granted certain very valuable and special rights by the state and local authorities which individuals and corporations generally do not possess, that these corporations are using the streets and public places—the property of the public, that the public is therefore in a sense a partner in the enterprise, and as such is clearly entitled to know what the firm is doing; that many corporations have a virtual monopoly; and that, having tried a policy of non-interference, experience has shown that the welfare of the individual, of the city, and of the state is not adequately protected without regulation and control."

Hence in advanced jurisdictions, public utility corporations are subjected to a special tribunal, namely, the Commission, whose jurisdiction enables it to control rates, to exact extended or improved service, and to decide questions on all matters arising between the Utility and a Municipality or private citizen, and of equal or paramount importance to impose a system of accounting and periodical report of financial results.

For practical purposes there are a variety of reasons for such accounting. Many of the provisions of public utility Acts are passed in the interest of shareholders, bondholders and mortgagees, in whose interest it is that there shall be supervision of accounts, and particularly that there be a due regard to depreciation, and by providing for depreciation, funds or reserves, ensure that capital is not impaired to make up dividends. The prominent instance of reference to such accounts is in rate questions to see if present traffic and the resulting revenues are such that reduction of rates may be ordered and still leave a fair return on the investment. The right to increase rates will conversely depend on the accounts showing that present traffic and rates do not produce such fair return. Improvements of service and extensions of plant and distribution equipment are frequently demanded. Here the financial capacity of the utility is a consideration, and an inquiry thereupon is an essential proceeding. Properly kept accounts duly reported to a Commission answer the questions at once. In highly profitable franchises where rate reduction for some reason may not be possible, as in the case of fixed rates of street car fare, there is the alternative course, frequently even more satisfactory, of requiring extended or improved service. All this is done in a spirit of the utmost fairness to the corporation. I again take the liberty of quoting from the invaluable opinion of Commissioner Maltbie. He said in this connection:—

An Invaluable Opinion

"An important reason for the general approval of highly differentiated forms of accounts is that they serve to protect and profit the thrifty and honest corporations. It is not the purpose of public regulation by reducing rates to take from a corporation all of the proceeds of enterprise and thrift that it may earn beyond a reasonable dividend. If a thrifty and intelligent corporation can, at a smaller expense to itself, supply a better public service than a careless and incompetent corporation, the former should not be compelled to charge the public less than the latter. To do so is to discourage progress and economy. The systems of accounts reported will show what corporations exercise care, economy and ingenuity in operation and good judgment in the selection of employees. Present obscure and varying methods of keeping accounts furnish no basis of comparison, and a tendency is to put the thrifty and unthrifty in the same class and seek to deprive the stockholders of the thrifty corporation of their fair rewards."

Proper accounting by such utilities is necessary in their own interests. Without a reliable system by which at any moment they can exhibit their financial burdens and gains they cannot meet attacks that may be made with only apparent justification. One of the chief benefits to be derived

from the standardizing of accounts is the possibility of comparing conditions in different places. Incidentally may be mentioned the power of a commission to require at any time an independent valuation or appraisal of a utility plant. This valuation provision is necessary in settling rate problems, the actual value of the plant and equipment, with cost of operation, being the true basis of rates. The valuation and accounting provisions are indispensable towards the supervision by the Commission of the issue by a utility of new stocks and bonds for which the consent of the Commission is required. Such, in a few words, are the salient purposes of accounting in the case of private franchise corporations. What about the like accounting by publicly owned utilities, by which are meant municipal undertakings? Does the necessity for public accounting exist? It does, for some of the reasons mentioned, but also for others. It is necessary to consider for a moment the special nature of such enterprises. The end to be gained by the pledging of the public credit for the installation of public utility plants is not always the same. Water service now naturally falls in this country to municipal authorities. That cannot yet be said regarding electric or gas plants, telephones, telegraphs, railways or tramways. There are increasing instances of publicly owned and operated electric and gas plants, telephones and street railways. These may be instituted from different motives. It may be that the field is new and private enterprise not at hand, or that reduced price of service is sought to be secured by means of public competition, or that existing private undertakings do not cover the field, and public action is imperative or is thought to be beneficial to the community.

Not Intended to Make Profits

It seems to be the intention in this country that these publicly owned plants shall not be expected to do much, if anything, in the way of making profits; this is so that the consumer may get service at cost. But equally well founded is the determination that such plants shall, when well-going, be made to pay their way and cast no burden on general taxation. Both private and public utility enterprises have their early periods of operating loss, while attaching business. Consideration must be given to this. In some municipal cases this loss may continue till the community increases in population, in which increase the very existence of the utility service in the community may be a factor. But allowing for all this, the desired financial end is that the utility shall be self-supporting. A municipal plant run at a loss means that taxpayers who do not use it, though they may remotely benefit from the fact that the plant is there, are paying for the service provided to their neighbor and not to them. In public plants there are no shareholders to be concerned. Bondholders have the whole assessable property to fall back on and so may not feel much interested in the finances of the plant. Questions of rate reduction are not likely to arise; so that the reasons for requiring accounting in public plants are not identical with those in private ones. Yet it is all-important that there be independent supervision of the accounting of publicly owned utilities and the enforcement of adherence to proper principles, and that this be likewise made the means of acquainting the taxpayers with what is being done with their money, and with the funds raised on the security of their property, and whether the administration is successful, and the financial result of the undertaking satisfactory. Every taxpayer is under a guarantee limited by the value of the property he owns for the debts of the municipal utility. He is entitled to know reliably the extent to which such guarantee is by reason of deficits converted into direct liability, and to know what the taxpayers in the municipality are paying for the privilege of having the utility. In municipal cases depreciation reserves are of the highest importance, else the present may be consuming the plant at the expense of the future. In cases where there is competition between a public plant and a private one it is but just that the same rules of accounting should apply to both. The principles of accounting are of course the same in both classes of utilities, but the leaning of the administrative bodies as to certain accounts may in one class be in a quite different direction to those in the other, so it has come about that in the case of a general public utility law municipal enterprises are subject to that law and to the same jurisdiction. This is expressly required in the Manitoba Act, which contains the provision that every municipality operating any form of public utility service shall keep the accounts thereof in the manner prescribed by the Commission for the accounting of similar public utilities, and shall file with the said Commission such statements thereof as it may be directed to do by the Commission. The simplicity of application and enforcement of the law in case of private corporations may not exist in the case of publicly owned utilities, but publicity and willingness to submit to authority invariably overcome impediments of that sort.

It is enlightening to observe the experience of a long-established Commission with the accounting by municipal utility managers. Chairman Roemer, of the Wisconsin Commission, in a public address, expressed himself thus:—

"The system of accounting prescribed by the Commission has for its basic principle such classification as will enable the ascertainment of the cost of service. Although it is self-evident that no business of such character can be successfully conducted without an accurate knowledge of the cost of rendering the service in which the utility is engaged, it was surprising to learn that while the best conducted privately owned utilities had in a measure recognized the importance of such information and had somewhat imperfectly attempted to ascertain the same, the majority of the managers of municipal plants had generally been wholly oblivious to the necessity of any such knowledge. . . . .

"Accounts pertaining to municipal plants were often merged with other accounts of municipalities, and even where separation was made the accounting was so crude and inaccurate that it was impossible to ascertain therefrom even approximately the cost of any class of service. In this connection, it may be said that the system of accounting prescribed by the Commission, although differing from that heretofore generally in vogue, has met with general approval among managers of privately owned plants, and those in charge of municipal plants who have endeavored to administer the affairs of the plant upon a sound business basis. . . .

"Installation of a system of bookkeeping to conform with the prescribed accounts of the Commission has been necessarily a somewhat difficult task, especially in the case of municipal plants. Many of the smaller utilities, which had hitherto evidently not seen the necessity of recording their transactions in a businesslike manner, have taken time to adjust their books to the accounting requirements.

"The local authorities in control of municipal utilities were at first slow to respond to the demands of the Commission, except in the most progressive communities. In some instances it appeared that those in charge of such plants were apprehensive that proper methods of accounting might result in disclosures reflecting upon the capacity or integrity of the management. In other instances, there seemed to be no one in the organization of employees capable of keeping a set of books intelligently. This was particularly true where the management changed with the municipal administration. However, in practically every community where the management was entrusted to a non-partisan board whose personnel was more or less permanent, there was no difficulty in securing hearty co-operation in putting into effect the prescribed system of accounting. Such boards were quick to recognize the benefits that would be derived from a uniform system of accounting. As the various plants are classified according to

size, comparison of results of operation between plants in the same class has proven of inestimable value to the managements of all plants, whether publicly or privately owned."

I proceed, therefore, with the consideration of this legislation as affecting both publicly and privately owned plants. The prominent type of the Acts respecting public utilities requires that each utility shall "keep its books, records and accounts so as to afford an intelligent understanding of the conduct of its business, and to that end that the Commission may require every such public utility of the same class to adopt a uniform system of accounting, which system may be prescribed by the Commission," and to "furnish periodically and whenever the Commission shall require a detailed report of finances and operations, in such form and containing such matters and verified in such manner as the Commission may from time to time by order prescribe."

What Canadian provinces have done

Such are the Manitoba provisions adopted from those of one of the United States. Of Canadian laws the Nova Scotia Public Utilities Act bears the closest resemblance. New Brunswick and Quebec have Public Utility Acts, but they omit those provisions of the now standard Public Utility law. The Act respecting the Ontario Railway and Municipal Board contains many Public Utility Act features, but lacks the accounting provisions. The Ontario Power Commission Act authorizes a uniform system and the regulation of bookkeeping in municipal plants. In Saskatchewan it would appear that the telephone utility is the only one dealt with in this way so far. In that province municipalities operating telephone systems are required to keep accounts thereof distinct from the general municipal accounting, and companies operating rural telephones are to keep accounts in form prescribed under statute. Accounting provisions are, of course, common in English general Acts respecting public utilities, such as railway, gas, water, and electric services, but it is safe to say that the definition of principles and close inspection by public authority have been brought to most advanced stages in Public Utility Acts. The provisions just mentioned are similar to the accounting legislation found in the Dominion and Provincial Railway Acts. These are content with requiring accounts to be kept and balanced periodically. Certain returns to the Minister of Railways in prescribed form are also required. But this does not introduce any uniformity of system of internal regulation or lay down any accounting principles or rules to be observed. There is conspicuously present the opportunity for elasticity of bookkeeping which it is the principle of Public Utility Acts to avoid. The outstanding feature of accounting under such acts is, as has been decided, and accepted without question, that the power to require a uniform system of accounting includes not merely the enumeration of the titles of the accounts, but also specific provision as to the method of keeping these accounts, the definition of terms used, and a statement of how various items shall be debited and credited; in short, in the system as it has developed where it is of longer growth it does not depend on the ideas of the financial management of a concern what shall be charged to capital and what to operating, what reserve shall be established, or what specific records shall be kept. The Commission, under the law, by a complete accounting code, prescribes all this. The utility is left free to establish such sub-accounts as it sees fit in its own particular circumstances, but that is the only latitude afforded to it.

The subject has been an absorbing one in various jurisdictions. It was found to be so important in New York that over a year was consumed in the consideration of the matter, accompanied by conferences between the two Public Service Commissions of that State, representatives of the Interstate Commerce Commission, other Public Service Commissions and Associations representing the various classes of corporations. Public hearings were held and various methods and suggestions submitted and considered before a definite scheme was reached. Even this was guarded by an expression that changes might result, as experience indicated possible improvement.

The system adopted as a result of the investigations mentioned, and brought up to date in the various states which have developed this law, is largely the result of the combined judgment of engineers and accountants, and is a monument to the high skill and intelligence of the authors. Thus the opinions of these professional men became crystallized into law. While it now appears in written form, just as does the common law in its repositories, it is nevertheless a common law derived from the sense of truth and right of those most qualified to declare it.

Accounting methods of utilities are not subject to any differing standards merely by reason of the fact that public act may be in force. Sound accounting is the same everywhere. There may be slight differences in detail in the rules laid down by different commissions, and questions may arise as to the applicability of rules to cases, but true principles are not affected by mere locality or by the existence of a jurisdiction. Under the public utility act sound accounting becomes law, where elsewhere it would be a business or moral standard without means of enforcement by law.

Division into Classes

It would take this paper to unreasonable lengths to enter into the different phases of the accounting processes defined for the various utilities. A few words by way of illustration must suffice. Certain rules are fixed by the law itself, viz., that the utility shall not capitalize any franchise to be a corporation or capitalize any franchise in excess of the amount actually paid to governmental authority therefor, or capitalize any contract for consolidation, merger or lease. Otherwise the accounting field is left to the discretion of the Commission, with the special expression that the Commission may by order require a proper and adequate depreciation account in accordance with such rules as the Commission may prescribe, and that the Commission may fix proper and adequate rates of depreciation.

It was obviously difficult for the Commission to frame a single system of accounting, going sufficiently into the details of the large companies or municipalities, and yet suitable to the limited operations of the small ones. This was met by prescribing certain classes. For instance, utilities were in Wisconsin given two classes, Class "A" being for utilities operating in municipalities of 10,000 population and over Class "B," for those operating in municipalities under that figure. Any utility in Class "B" which desired a more detailed classification might open the accounts prescribed for Class "A," and any utility in Class "A" desiring a more detailed system might go into as much sub-division and refinement of each of the submitted accounts as its interest required, but was not allowed to rearrange or combine any two or more of the accounts in such a manner as to interfere with the integrity of the general scheme, and so destroy the possibility for comparisons. In some of the jurisdictions the classification is based upon the amount of the revenue of the utility, the division points being fixed at such figures as $500,000 and $100,000, but all the accounts being so arranged under such main headings that the transition from the smaller to the larger is easily effected.

Features to be attained under this control and regulation of accounts include the due charging in each year's accounts of the due and proper portion of fixed capital consumed in that year, so as to ensure that a sufficient amount will be expended or set aside to keep the property up to the proper standard, and, on the other hand, that an undue amount is not taken out of earnings to be spent on the plant, and thereby form a concealed reserve; the establishment of deprecia-

tion provisions arrived at on reasonable estimates and the observances of the fine distinctions that pervade that subject, the disposition of overhead charges and expenditures on what are termed intangible assets, and various other phases of more or less importance. These provisions have been defined in elaborate codes drawn to suit the various utilities and the different classes of each. They were, as stated, evidently based on the combined experience of accountants and engineers, who had specialized upon the work. The Commissions have always for such purposes the advantage of a competent expert staff, or are by law enabled to resort to such assistance whenever occasion requires.

The observance of a code so framed will not be found oppressive, and will not only meet the public demand involved, but will repay the utility itself by introducing method and enabling the owners, whether public or private, to be quickly and accurately informed of their position at any time. It needs no demonstration that it will be beneficial to an electrical utility, for instance, to so classify its income account as to show separately its revenues from Commercial light, Municipal light, Commercial power, Municipal power, and its non-operating revenues, and to classify operating expense accounts, such as power, transmission, storage, distribution, commercial, salaries, rents, etc., contribution to depreciation reserve, taxes, interest on funded and other debts, sinking fund requirements, etc., and that its balance sheet accounts shall contain account for intangible capital such as organization, franchises and plant equipment, transmission and distribution systems, general office equipment, stores, expenditures during construction, reserve accounts for depreciation, sinking funds, amortization, maintenance and uncollectable accounts, current assets accounts, accounts of capital liabilities, mortgage liabilities, current liabilities and accrued liabilities, the whole being according to detailed direction, of easy comprehension and application, as to what shall or shall not be included in any account.

I bring this paper to a conclusion, believing that you will agree with me that the case is made for the accounting of public authority in respect of both private and municipal utility concerns. Our country being newer, the need in the public interest of the regulation and control of franchise companies has not become impressed on us as it has upon our neighbors ot the south. There, strongly intrenched interests held franchises of long standing, cheaply obtained and perpetual or virtually so, and now become of inestimable value. The public service law was the remedy for abuses or neglect. The eager desire to secure the introduction of a utility may induce the grant of a franchise without due consideration of its potential value. That such has occurred in Canada need not be said. It is inevitable that measures of just regulation and control, shall become general here as in the neighboring states.

The important part to be played by the accounting profession is obvious. The public utility laws have made that profession part of the system. The Commissions have recognized and declared to these utility enterprises that the skilled accountant is indispensable to them for their own welfare. But there is a responsibility, and it is a heavy one. It is that the Commission and the public are entitled to know without the slightest suggestion of doubt that the accounting results furnished and certified by any chartered accountant on behalf of a utility are the result of the intelligence, accuracy and fidelity which characterizes the profession. The accounting profession is thus expanding in its public importance and responsibility.

The science of accounting developed with commerce. Invention and discovery produced immense growth of industrial enterprise. The vast capital employed in mammoth undertakings, both public and private, brought with it complexity of financing, and inevitably required as its indispensable adjunct an accounting profession of infallible skill and reliability, and thus not only to institute and preserve its memorials, but to guide and often restrain constructive genius and courage.

And so your profession, ever ready, keeps pace with the march of progress, until now we find it taking essential part in functions of government. It may be either in the regulation of the exercise of a franchise granted by the sovereign power or in the administration of the people's undertakings. In whichever it be, your profession will maintain its traditions and fully reward the confidence now so amply reposed in it.

Personal

Mr. H. C. F. Poste, formerly superintendent of the Canadian Light and Power Company, at St. Timothee, P.Q., has been appointed superintendent of the entire system of the company.

Mr. D. W. Smith, lately with The Westinghouse Electric & Manufacturing Company, has associated himself with The Robbins & Myers Company in the position of Manager of Motor Sales.

Mr. Geo. L. Hatheway who formerly travelled a portion of Canada, and New York state for Pass & Seymour, Inc., is now spending all of his time in Canada in the interests of this company. Mr. Hatheway was formerly manager of sales of the Fullerton Electric Company, of New York. He expects to permanently locate in Canada, and will probably maintain an office in Toronto.

Mr. R. G. Black has been appointed by the Ontario government as their representative on the Toronto Hydro-electric Commission, a position vacated some time ago by Mr. H. L. Drayton. This Commission consists of three members, composed as follows:—Mr. P. W. Ellis, Chairman, appointed by the city of Toronto; Mayor Hocken, member ex-officio; and Mr. Black, the government's appointee. Mr. Black's appointment will meet with universal approval.

Mrs. Lena Williams.

Mr. H. A. Worby, manager of the Westbury Electric Light & Power Company, Cookshire, P.Q., is particularly fortunate in his choice of operators. For the last year and a half his daughter, Mrs. Lena Williams, has taken complete charge of one shift each day with perfect satisfaction to the owner of the plant, as well as to the customers. We believe this is the only case in Canada of a lady operator of a light and power plant. Mrs. Williams, whose photo is reproduced herewith, is the wife of Mr. Elmer Williams, power electrician of the Westbury plant.

An interesting book has just been issued under the auspices of the city council of Hamilton, Ont., which outlines the history, commerce, industries, and resources of that city. The book is handsomely bound in stiff linen covers, and splendidly illustrated and printed.

The preface states that thanks for the preparation of this book are due to Mr. H. M. Marsh, Commissioner of Industries; Mr. T. L. Brown, Secretary of Board of Trade; Mr. A. F. Macallum, City Engineer; Mr. W. E. Carey, Financial Agent; Dr. James Roberts, Medical Health Officer; Mr. E. I. Sifton, Chief Engineer of the Hamilton Hydro-electric system; Alex Metherell, real estate broker, and others.

Testing of Telephone and Telegraph Lines*

A Series of Short Articles Based on the Author's Practical Knowledge and Experience—Applicable to Plant of Any Size or to Any Manufacturer's Equipment

By Mr. T. H. Nicholson

There are a large number of standard arrangements of the Wheatstone bridge that have been evolved from time to time by different manufacturers, and as required for different purposes. These can all be made to serve our purpose by more or less extended manipulation, but, owing to the frequent use demanded of them in telephone service, the one needing the least preparation, and the least amount of calculation after a balance has been obtained, is evidently the one to be desired.

The three bridges here shown are typical of those in general use in this country, for use where a simplified ohmmeter or direct reading faultfinder is not accurate enough for the class of testing in hand, especially on long distance lines

Fig. 7 shows the connection of the Post Office type of bridge which although it has some objectionable features, as before explained, is very easy to operate, and in addition has the advantage of being comparatively cheap, owing to the small number of coils and contacts required. In this instrument advantage is taken of the fact that with the figures 1-2-3-4 any number from 1 to 9 (or if necessary 1 to 10) can be obtained, so it is only necessary to have four sets of four coils each for the complete rheostat or "R" arm.

In the illustration it will be noted that the plugs have been removed from the 1, 3 and 4 units, the 2 and 3 tens,

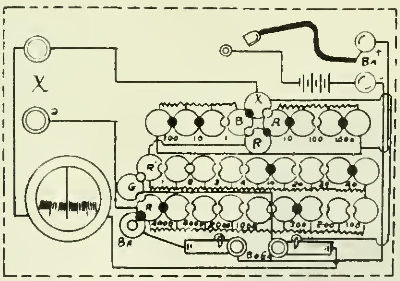


Fig. 7—Diagram of connections, Post Office Wheatstone Bridge.

the 1, 2 and 4 hundreds and the 1, 2 and 3 thousands. These all added together in three respective values will give the value of the rheostat adjustment, which is 6,758. The A and B arms are unplugged at 100 and 1 respectively, so that from the rule, the resistance indicated must be 675,800 ohms.

The trouble often experienced with the plugs from poor contact, and the constant uncertainty as to their condition when testing, together with the necessity of adding up the unplugged coils to get results, led to the development of the decade type of bridge which is shown in Fig. 8.

In this instrument the rheostat is arranged in decades, that is—the units, tens, hundreds, and thousands have each a complete set of coils from 1 to 9, and with an arrangement of busbars, or common contacts, all in series, any one coil in each decade can be connected into circuits. Only one plug can be used in each decade, as any other plugs would simply put the coils affected in multiple with the rest in that decade. When a balance has been obtained it is only necessary to read across the decades, using the plugged units to find the value, which in the figure is 6,190. The relation of this to the "X" resistance, as in other bridges, then depends on the relation of the A to B arms.

When the necessity for frequent testing of telephone lines came to be realized, and the possibility of close location of line troubles appreciated, it was seen that a further im-

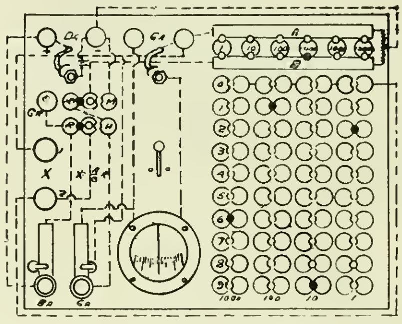


Fig. 8—Circuits of Decade type of Wheatstone Bridge.

provement could be effected by avoiding the plugs in bridges altogether. This resulted in the Dial-Decade type of bridge shown in Fig. 9, which is the latest development in this instrument for ordinary testing.

Each of the dials has a sliding pointer which makes contact with one terminal of a coil in a manner similar to that followed with a plug decade bridge, with the advantage that the dial can be adjusted easier and quicker than the plugs. The method of reading is of course just the same.

In the first instruments of this type some trouble was ex-

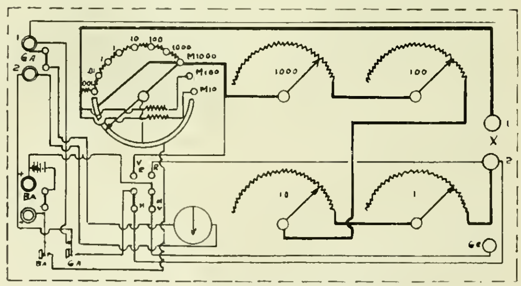


Fig. 9—Circuit and arrangement of Dial-decade type.

perienced with the contacts becoming dirty or weak, but further development has solved most of these difficulties, especially in some makes where the contacts are mounted inside the case, only the index pointers appearing on top, so that it is possible to obtain an instrument as nearly perfect as can be reasonably expected.

The bridge shown in Fig. 9 also includes another improvement that was made possible with dial manipulation. This is the use of a dial controlling the A and B arms so arranged that the multiplier is indicated directly on each setting.

Electric Railways

Saskatoon's Track Construction

The sketch herewith illustrates the type of track construction used on Saskatoon's municipal system. On paved streets the 85-pound high T rail is used with 8 feet by 8 inch by 6 inch ties, two foot centers, with five inches of solid concrete under ties, and filled with concrete to a two-inch crowning. The groove for the wheel flange consists of a strong mixture of concrete with wire reinforcing six inches wide, which makes a very strong job. The radius of curves ranges from 55 feet to 225 feet of heavy steel. Skeleton track work on the unpaved portions of the system

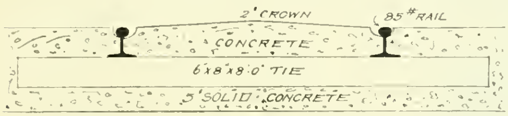


Diagram showing track construction, Saskatoon

consists of 60-lb. steel, ties 20 inch centers, with 6 inches of good gravel under ties, bonded with 32 inch pressed bond, under continuous rail joints. This skeleton track is crowned under centre to top of tie with gravel, with a decided drop from centre to end of ties on either side to allow water to drain off. Mr. Edward Hanson is superintendent of Saskatoon's street railway system, adding these duties to those of city electrical engineer.

Track Construction on the W. E. Ry. system

The accompanying line drawing represents a cross-section of the standard construction work on paved streets of the city of Winnipeg. A 7-inch T-rail, Lorain section, 80-335, is used with 6-inch stone setts placed longitudinally along both sides of the rail and asphalt pavement in between. The company consider the T rail to be the best construction for maintenance, also for vehicular traffic, as it enables heavily loaded vehicles to turn out of the flange-ways easily.

On the sub-grade the figure shows that the company put in a 4-inch earthenware weeping tile drain under the centre of each track. This is found necessary owing to the extreme flatness of the city of Winnipeg which is very difficult to drain. All the weeping drains are laid to grade and connected to sewers.

The sub-grade consists of 3 inches of broken stone which is rolled until thoroughly consolidated. On top of the broken stone is placed 6 inches of concrete under the ties and the concrete is continued 1-inch above the ties to receive the stone setts. When the stone setts are placed and set there is put on what is called the top concrete, to the under side of the asphalt pavement, which is about 3 inches thick. It will be seen from the figure that the track is not crowned.

The cross-section, with dimensions, of the rail used, is shown to the right of the figures. Continuous rail joints are in use throughout.

Chicago Railway New Cars

The final plans for 200 new cars for the Chicago Railway Company have been completed and the contracts let. They are to be built, 50 by the American Car Company, 50 by the Southern Car Company, and 100 by the company itself in their 40th avenue shops. The first deliveries from the builders are expected by the middle of October.

These cars are to be of the arch-roof type of construction with the lines of the car practically the same as the standard car now in use. Considerable effort has been expended to keep the weight down with the result that it will probably not exceed 37,000 lbs. All-steel underframes are to be used and will be built by the American Bridge Company for all 200 cars. The underframe weighs approximately 4,000 lbs. The side girders, as shown in detail in the accompanying drawing, are made up of a 30-in. plate of No. 12 gauge steel which extends up to the window rails and forms the outside panel of the car. This feature aided materially in reducing the weight. The bolster will have a steel casting and be so designed as to give adequate strength with comparatively light weight.

The new cars are to be built for double end operation with the platform arrangement practically the same as that on the older cars. The total car length will be 48 ft. 5 ins. and the platforms are 8 ft. long. The heights of the steps have been lowered quite materially and will be 12½ ins., 11 ins., and 10 ins. respectively as one enters the car, and there will also be a ramp from the end sill to the bolster of 2½ ins. in 5 ft. The floor will be 36 ins. above the rail at the bolster and 33½ ins. at the end sill. The front exit step will be arranged to fold up with the door mechanism. The seating capacity of the interior of the car has been increased from 40 to 48 and in addition folding seats will be

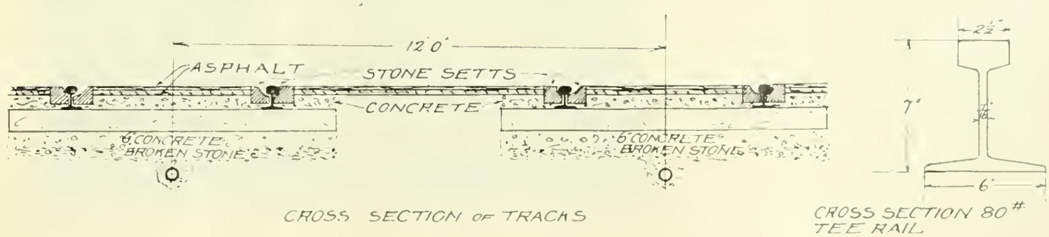
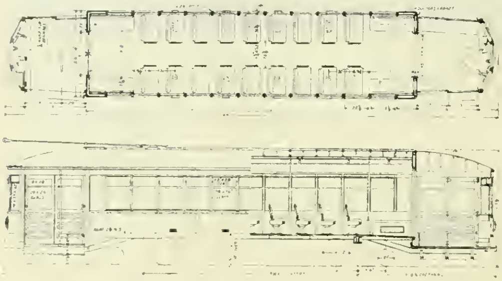


Diagram showing track construction, Winnipeg

provided on the front platform which accommodate five passengers, making the total seating capacity 53. This is a 32½ per cent. increase of the interior capacity. The interior of the car will be finished in cherry and rattan seats used.

The Brill 39-E trucks are to be used with a 32-in. driver wheel and a 21-in. pilot wheel. Two Westinghouse fully ventilated field control motors No. 534 Y-1 of the box type will be used on each car with a 15-69 gear ratio and 3 pitch gears. The brake equipment will be supplied by the National Brake Company. The cars are to be ventilated by the Cooke sys-



Plan and side elevation—Chicago's New Cars

tem and the air intake is to be made through louvres in the side of the car instead of the floor, thus eliminating the dust trouble to some extent. The new cars are expected to make a saving in energy consumption per car of not less than 25 per cent.

The new car has been designed by the equipment department of the company, under the direction of Mr. H. H. Adams, superintendent of equipment.

Miscellaneous Trade Notes

The Sterling Telephone & Electric Company, Limited, 200 Upper Thames Street, London, E.C., England, announce that at the end of September they will remove to more commodious premises situated at 209-212 Tottenham Court Road, London, W.C., England.

On August 9th the city of Springfield, Ohio, witnessed a parade of the employees of the Robbins & Meyers Company which was quite above the ordinary and was one of the most interesting demonstrations of industrial strength that that city ever witnessed. The event was the annual picnic of the employees of that company.

On September 1st the Lancashire Dynamo & Motor Company moved to new premises at 107-109 Duke Street, Toronto, where they have greatly increased facilities for the handling of stock, thus preventing delays in shipment hitherto unavoidable. The company are also greatly enlarging their stock and will be able to meet orders promptly.

Mr. Edson O. Sessions announces that he has opened a new office in the Marquette Building, Chicago, where he will carry on the business of consulting engineer. Mr. Sessions' experience comprises over twenty years service in construction and engineering work. He is a fellow of the A. I. E. E., a member of the A. S. M. E., an associate of the A. S. C. E., and a member of the I. E. S.

The Ohio Brass Company announce that they are now manufacturing all-wire rail bonds with pin driven terminals. All types and forms of this company's bonds, which have been furnished with compressed terminals, are now furnished in addition with the pin-driven terminals. The new bonds have embodied in them the same features which have characterized the older types, namely, terminals and body made of the same strands and the strands protected by thin copper sleeves at the point where they are welded together to form the terminal.

Mr. Herbert Berry, of Messrs. Berry, Skinner & Company, London, Eng., is paying his first visit to Canada. His firm are manufacturers of a very full line of fool-proof switch-gear, including switches for house services where a sealed device is provided. Cast iron cases are used in place of the usual method of thin sheet steel boxes. Mr. Berry reports having secured some very large orders. It is only by the principals of British firms visiting this country that the peculiar needs of Canada can be ascertained, and Mr. Berry has taken the most effective way of introducing his goods to Canadian consumers.

Trade Publications

When the Ship Comes In—A booklet issued by the Canadian General Electric Company describing Type W long life flame arc lamps for use on docks, wharves, passenger and freight terminals, etc.

Foos Gas Engines—Catalogue 91 distributed by the Canadian Allis-Chalmers, Limited, Canadian selling agents for Foos Junior gas and gasoline engines. These engines range from 2 to 8 horse-power.

Cranes and Hoists—A sheet issued by the Herbert Morris Crane and Hoist Company, Limited, Peter Street, Toronto, describing the Morris Q. E. F. Runway equipment for the quick handling of heavy material.

Fire Alarm System—Circular No. 15101, issued by the Holtzer-Cabot Electric Company, descriptive of a firm alarm equipment specially designed for schools. The equipment is well illustrated, and diagrams are shown illustrating the proper method of installation.

The 1913 Code—The National Board of Fire Underwriters has just distributed its 1913 issue of the National Electric Code, containing the rules and requirements of the National Board of Fire Underwriters, for electric wiring and apparatus, as recommended by the National Fire Protection Association.

Pittsburg Insulators.—Catalogue No. 3, issued by the Pittsburg High Voltage Insulator Company, Derry, Pa., U. S. A. In this catalogue only such insulators as are now considered standard and of approved design have been listed. The diagrams are very complete as is also the descriptive information which accompanies them.

Charging Storage Batteries—The Canadian General Electric Company have issued a very useful instruction sheet regarding the charging of storage batteries with mercury arc rectifiers. This sheet is for use as a continual reference and if tacked up near the rectifier and frequently consulted will guard the operator against many common errors.

Dynamos and Motors—Pamphlet No. 18B issued by Bruce Peebles and Company, of Edinburgh, through their Canadian agents Messrs. Roper, Clarke & Company, Montreal. This pamphlet deals with the Peebles continuous current dynamos and motors, large size, open type, and gives fully detailed specifications, numerous illustrations, weights and dimensions of the different sizes lists of ratings with technical data, etc.

Illumination

Ornamental Street Lighting in Calgary

By Mr. L. Burpee

Calgary is one of the most progressive cities of the Canadian West, and is justly proud of the progress she has made in the last six or seven years. This is shown conclusively in the growth of public utilities, which are municipally owned, one of the most important of which is the illumination of the business streets.

The city of Calgary has now a population of about 75,000, and there are 201 miles of streets, lighted by 240-250 watt, 6.6 ampere, series tungsten lamps and 860 arc lamps.

Not content with this good lighting, however, the city, last year, passed a by-law authorizing the installation of ornamental cluster standards, equipped with five 100 watt tungsten lamps, on 7th and 9th Avenues, 1st and 2nd Streets, East Centre Street, and 1st and 2nd Street West. The by-law also provided for ornamental luminous arc lamps of the C. G. E. type, on 8th Avenue. This comprises the business section of the city.

There is nothing out of the ordinary in the installation of the tungsten clusters. They are placed on both sides of the street, at about the usual distance apart, and at the usual height above the pavement. The ornamental arcs on Eighth Ave., however, are installed on ornamental brackets, attached to the street railway trolley poles, at such a height that the arcs are 16 ft. 4 in. above the sidewalk. The brackets are about 30 inches long, so that the lamps project out over the avenue by about two feet. Due to unequal spacing of trolley poles with respect to city blocks, there are ten lamps in one block, and twelve in the next. Two circuits are carried along each side of the avenue. These are supported on cross arms near the tops of the poles. The lamps are connected into these circuits in such a manner that if for

General effect of Luminous Arcs on Eighth Ave. Calgary

Front lighted by Magnetite Arcs—Side lighted by Tungsten Clusters

any reason one circuit is out, half of the lamps on both sides of the avenue will be lighted. This serves the double purpose of facilitating, cutting out half the lamps each night at eleven o'clock (Saturday night twelve o'clock), and of reducing interruptions in the lighting to a minimum.

The accompany illustrations from photographs taken between ten o'clock p.m. and midnight on a dry dark night afford some idea of the excellence of the illumination of Eighth Avenue. The by-law already mentioned, has lately been changed to authorize the installation of C. G. E. ornamental luminous arcs, instead of cluster lights, on all streets and avenues enumerated above, except Ninth Ave., involving a total of about 375 lamps.

Now that the type of illuminant has been decided upon, the city is determined to put in an installation in every way second to none. One steel pole will be used where now there are three sets (wood and steel). This pole will be used in common by the Railway & Lighting Departments on streets and avenues having car service. The absolute cutout will be placed in an ornamental cap or hood on the pole top, and

wires will pass down to the lamp inside the pole and bracket. On the streets and avenues on which there is no car service, ornamental standards will be installed, the circuits being placed underground. Telephone wires will also be placed under ground.

The entire cost of the installation is paid for on a foot frontage basis, on ten-year debentures, the city paying operating and maintenance costs.

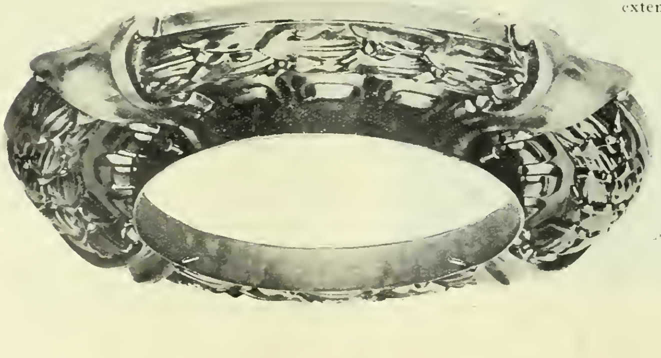
Temporary Lamp Receptacle

The receptacle herewith illustrated has been designed primarily for temporary work. It can easily be connected in circuit, because it is unnecessary to strip the insulation from the wire. The wire is placed opposite the screw, which is

then tightened so that the point at the end will puncture the insulation and make contact. This receptacle is made of mica compound and will withstand rough handling. It has been placed on the market by Pass & Seymour, Inc., Solvay, N.Y.

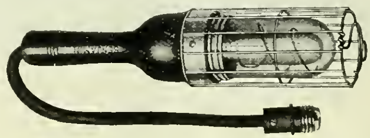
Ready-to-Assemble Fixtures

The handsome illustrations shown herewith are typical of the metal fixtures and fixture parts manufactured by the W. H. Banfield & Sons. This firm manufacturers a great variety of designs of ready-to-assemble fixture parts and fittings in stamped brass as well as electrolier chains in a great variety of designs and finish. Another prominent feature of their products is a swivel loop which is also made in a number of different designs. Catalogue No. 2, just issued, is splendidly illustrated and tells all about these latest designs, with prices.



New Benjamin Vapor Proof Hand Portables

The Benjamin Electric Manufacturing Company of Canada, Limited, Toronto, are putting on the market a new form of vapor-proof hand portable which is designed for use in garages, dyeing and cleaning works, and places where gases or inflammable materials are found. As shown by the accompanying cut, it consists of a strong wooden handle, medium screw base, porcelain receptacle with lamp grip for



tubular lamps mounted in cavity, a vapor-proof globe with lamp centering spring and wire guard with hinged hook. It is $13\frac{1}{2}$ inches long and measures $2\frac{1}{4}$ inches in diameter. The guard can be supplied complete less cable and attachment plug or complete with one foot of cable and swivel attachment plug.

Consolidated Tungstoliers

The Tungstolier Company of Canada, Limited, announce that they are placing on the market a new line of fixtures known as the Consolidated Tungstolier Bulletins and descriptive matter are being distributed.

Montreal Underground

Work has been commenced by Mr. G. M. Gest on the Bleury street section of the Montreal underground conduits. Mr. Gest has now a very large amount of work in the district. He has three contracts for the city of Montreal and also one for the town of Outremont, a suburb of the city. Considerable progress has been made with the St. Catherine street contract, many of the big manholes being completed. The commissioners who are responsible for the entire work are engaged in drawing up plans for the inner central district, and it is hoped to call for tenders early next spring. The civic controllers had asked for the removal of the poles on Victoria Square, but the Commissioners are not able to comply with this request; the Square, however, will be included in the work to be commenced early next year.

Bracebridge, Ont.

The town council are installing a small number of Jandus Luxolabra, carrying five tungstens, on their main streets. If this test installation meets with favor, the system will be considerably extended.

Brantford, Ont.

The municipality has purchased 132 ornamental cast iron standards, which will carry Canadian General Electric four ampere magnetite arc lamps. The current will be supplied through mercury arc rectifiers. The transformers for Brantford sub-station will be supplied by Crocker-Wheeler Company, and the switching equipment by the Canadian General Electric Company. The service wires for the street lighting system will be armored cable, laid underground.

The Dealer and Contractor

Advertising With Special Reference to Electrical Contractors (con.)

By Mr. P. L. Miles

As a result of this work which was being done in connection with the development of the new house wiring business, contracts for the wiring of new stores began to come in. As in the case of the residences, this class of business was handled entirely by architects and general contractors, and gradually the salesman worked up quite a number of store-wiring jobs.

All of this development work, however, was placed on a routine basis and the salesman again found himself with little to do. He suggested to the contractor that they go after the store business, where gas was used for illuminating purposes. The salesman prepared a list of about 125 stores which were lighted by gas. This list he obtained from a personal canvass of stores after dark, jotting down the name of the firm and the address. This prospect list was then circularized by a series of four letters. One letter contained a return post-card, upon which was a request for the salesman to call and give additional information. It was stated that the prospect would place himself under no obligation by making this request and that they were only too glad of an opportunity to present their proposition. The newspaper advertisements were continued but were slightly changed to read that the firm was specializing in the lighting of stores.

The co-operation of the local lighting company was then sought in conjunction with this campaign. As a result, a central station salesman was delegated to work in conjunction with the contractor's salesman. Together they called on the store owners who had sent in the post cards requesting additional information. When this was finished they called on every one included in the prospect list. The central station salesman gave an estimate of the average monthly current bill, told of the advantages of electricity, how it could be used for other purposes, etc. The contractor's salesman gave the merchant an estimate of the cost of wiring, fixtures and lamps. Together they brought out the reasons why the merchant should discard gas and adopt electricity for the lighting of his store. The contractor felt sure that 90 per cent. of the merchants would eventually wire their stores. It might not be for one, two or three years, but when they did, they would come to him to do the work. He felt that after the campaign he would be given the first chance at the business in nine cases out of ten.

Every year just before the fall lighting season, these merchants will again receive a series of letters and afterward a call from the salesman. The contractor feels certain that some each year will sign the contract to go ahead and do the work.

Advertising alone did not increase this contractor's business over 100 per cent., but it did play a very important part in this increase. It was advertising, backed up by proper selling methods, and according to the contractor, this combination "can't be beat."

The results from these campaigns clearly show that advertising does pay—and pays well if properly put to use. Millions of dollars are annually spent for advertisements in developing other lines of business. In the last analysis the problem of the electrical contractor differs but slightly from these other businesses. The contractor has something to sell and the one way to sell it is to let people know that it is there and then to induce them to make use of it.

There are two divisions into which the advertising done by a contractor may be divided, namely, general publicity and the advertising direct to prospects.

General publicity is the advertising of the firm name and what that firm does. The result of this publicity is the creation of a reputation and a good standing in the community served. It also creates confidence on the part of the public as it is a well known fact that people believe in firms with which they are familiar and who they know are firmly established in business.

Another value of general publicity is the connecting of the firm name with the business which they do. As an instance, if a man is contemplating having a wiring job done, he immediately endeavors to call to mind who in his city does that class of business. And the more familiar he is with this firm the more likely he will be to get in touch with them and at least get an estimate for the work.

The question of curbstone wiremen might well be mentioned at this point. Nearly every electrical contractor at some time or other meets with this class of competition. It is an easy class of competition to meet providing the proper arguments are presented. In this day and age people like to do business with concerns who they know are to be trusted. They want to know that when they give a job for wiring that it will be done in the best possible manner. The business reputation of a contractor is one of the strongest arguments which can be presented to offset curbstone competition, and advertising plays an important part in establishing this reputation for reliability.

An illustration will explain this more fully.

Reputation Counts

Mr. A. is going to wire his home. Mr. Contractor and Mr. Curbstoner are competing for the work and Mr. Curbstoner has the better of the argument in the matter of price. Mr. Contractor says to Mr. A., "You know very little or nothing about electrical wiring. It is surely worth a great deal to you to know that this work will be done in a shipshape manner. It is true my price is $10 higher than your other bid. Yet isn't it worth that much to be assured that the material placed in your house will meet all of your requirements? We could put poorer material but that is not the policy of our concern. We know what is required to give you a first class installation and that is what you will receive if you give the job to us. When we have finished every possible precaution will have been taken to prevent fires. Your circuits will not be overloaded. Our business reputation is back of us and you can rest assured that if by any chance any work is not done to your satisfaction or to the satisfaction of the insurance men it will promptly be fixed."

Mr. A. knows this is true. He has seen Mr. Contractor's

advertisements in the newspapers. He knows little or nothing about Mr. Curbstoner. He can usually be convinced that the advertising phrase, "It costs more but it is worth it," is true.

So much for general publicity. Advertising direct to prospects is an entirely different nature. The first purpose of this advertising is to make people want electricity.

After this such advertising should be designed to convince them that they can afford to install it. This advertising, however, cannot be expected to bring in signed orders, as was found by the contractor mentioned above. This does not prove, however, that advertising is of no value. Hard headed automobile manufacturers spent thousands of dollars in advertising high priced cars, yet it is very seldom, if ever, that they received, through the mail or by telephone call, an order to send one of their cars to a certain address. Some articles such as candy, soap and small household utensils can, and are, sold by advertising alone. But when advertising to obtain a contract for wiring a house, which requires an investment of from $30 to $100, fixtures included, the advertisement is eminently successful if it succeeds in bringing only an inquiry. When the inquiry has been received, salesmanship should do the rest.

Don't Neglect Inquiries

The inquiry should be taken care of immediately. Numerous instances are known where a great deal of money is spent on advertising which will only produce inquiries and then, after the inquiry has been received, it is neglected. Somehow or other it should receive immediate attention, either by a letter of acknowledgement or by the call of a representative the following day. With proper sales methods a very large percentage of inquiries may be turned into actual dollars and cents. This relation of the contractors advertising to salesmanship cannot be magnified to too great an extent. While advertising may not be absolutely essential to selling, yet selling is the logical follow-up of advertising. Advertisements do not take the place of salesmen. They merely tell his story to thousands, where he could only tell it to tens. It increases the effect of his work several fold. The advertising will arouse the interest of the prospect and after this has been accomplished the salesman can step in and close the contract.

An analysis of a prospect list for house wiring will show that the names naturally divide themselves into three general classes, namely, the home owner, the tenant and the landlord. Of these three classes much better results will be obtained from the home owner. The tenant as a rule will not bear the expense of the wiring, inasmuch as he may want to move and his expenditure will be lost to him. The landlord will not wire the house unless he is practically forced to do so by the tenant. In some instances, however, it is a comparatively easy matter to induce the landlord to wire his house when vacant, arguing that it will be easier rented and with the lesser argument that there will be a great saving in redecorations. But as stated above the home owner will prove the most valuable prospect. He owns the home in which he lives and is heartily interested in the comfort and welfare of his immediate family. The expense which he makes in connection with wiring his home materially increases the selling value of his property. Instances have been known where, with an expenditure of only $75 for wiring and fixtures, an owner was able to demand $250 more than his original selling price. When looked at from the proper viewpoint, the home owner is not undergoing an expense, but is making a good investment which may bring good returns.

As shown by the experience of the previously mentioned wiring contractor in obtaining the business of wiring new houses, it is a combination of price and business reputation which will bring results. Practically all the dealings are with the architect or general contractor, the actual owner seldom interfering in matters of this sort. It is not necessary to induce these people to make any additional expenditure for wiring—this having all been decided with the laying out of the plans. According to central station managers practically 99 per cent. of all new houses are wired for electricity when built—and this without the call of a salesman. Electricity is the modern light and people want it in their new home.

The obtaining of this business, therefore, resolves itself into becoming acquainted in one way or another, with the architects and builders—showing them that your work will be entirely satisfactory and that the price is consistent with the quality of the labor and material to be furnished. Advertising alone can be of very little assistance in obtaining the business. The price and quality of the work play the important part, supplemented by good salesmanship.

The various advertising mediums which are available to the electrical contractor consist of direct-by-mail letters, including pamphlets as enclosures, show windows, the daily newspapers, programs, street car cards, billboards, electric signs, and stereoptican slides for moving picture theatres. By far the most important of these is the use of the mails. This should be the basis of the campaigns, the other forms of publicity being used in conjunction.

The newspapers are especially valuable for the purpose of general publicity. But when it is possible to obtain a list of prospects, every one of whom may be interested in the subject of electric wiring, it is of paramount importance that this be reached by letters and pamphlets, and this advertising supplemented by the uses of the newspapers.

Just a few words relative to developing the sale of electrical appliances, portables and lamps, which are handled by quite a large proportion of the wiring contractors. Advertising plays a very important part in the development of this business.

First of all, who are the only prospects for these articles? Electric light users, and electric light users alone. People whose houses are not wired for electricity are not in a position to use any of these appliances, and advertising material sent to them is practically wasted. They are the people who should be interested in house wiring.

An absolute list of electric light users is, of course, the list of central station customers. This list includes practically every prospect in a specified town. This list as a rule may be obtained from the central station manager. He realizes of course that every flatiron which is sold means additional current consumption to his company. In towns which are lighted by a municipal plant the record of customers is usually open to the public and may be abstracted in a day or so by a stenographer.

Once such a list is secured it should be worked to the limit. Many progressive contractors having a list of central station customers, are circularizing these names with a letter or pamphlet every month. This advertising deals with some seasonable subject, such as fans in the summer time and electric radiators in the winter time.

Window Advertising

Much has been written about the value of the display window as an advertising medium. Yet horrible examples of neglected windows are constantly recurring. In some even the plate glass is not kept clean but is dirty and grimy. In others the merchandise is literally dumped into the window where it is allowed to stay for three or four weeks, with the accumulated dust and tarnish. All of this reflects on the store, and gives it the earmarks of sloth.

The advertising value of the show window lies principally in the fact that people may see the actual goods—not merely pictures—and after seeing, they may make a purchase by going into the store. The more attractive the more likelihood of bringing them into the store. They do

not have to go out of their way—the store is directly in front of them. It requires very little time and planning to install a good window display—an hour will do the trick. Window displays are of known value—and their neglect on the part of any merchant is neglect of an excellent business opportunity.

The individual preparation of pamphlets and booklets, as well as that of newspaper cuts and copy, is usually a very expensive proposition—entailing greater expense than could be borne by the average contractor. For instanuce, in the preparation of a booklet on house-wiring in a 1,000 lot quantity the expense would probably be 10 cents apiece, or $100. Yet if these books were prepared in 100,000 lot quantities, the expense would run as low as 2 cents or 3 cents apiece, which is a material reduction.

Nearly all of the manufacturers have booklets, pamphlets, newspaper cuts and copy, which they will furnish to the electrical contractor, imprinted with his firm name, and dealing with practically every phase of the development of the contractors' business. Many of these features are furnished free of charge, while for others a very small charge is made, practically one-quarter of the cost if the individual contractor prepared the advertisement himself. Also very few contractors have, or can afford, a publicity man or rely upon an advertising agency to prepare the advertisement. This is both expensive and many times unsatisfactory. The manufacturers have advertising experts who devote practically all their time to advertisements relative to certain classes of business. They study the conditions and are in an excellent position to furnish the best material obtainable. There are at present four or five booklets on house wiring, as well as numerous pamphlets relating to the sale of lamps and electrical appliances, which could be successfully used by the contractor. Upon request, most of the manufacturers will submit a series of form letters, prepared by their advertising man, which may be used in connection with campaigns.

New Type Annunciator

The Connecticut Telephone & Electric Company of Meriden, Conn., have recently placed on the market a new type of electrical reset annunciator. The outfit contains many new and interesting features for the electrical trade.

Heretofore annunciators have been built mostly of the mechanical reset type. The demand, however, seems to be increasing for the electric reset style. The Connecticut annunciator drop consists of two independent magnet coils. One operates the drop and the other resets it—there are no permanent magnets of any kind. By a unique and positive arrangement only the independent reset magnet is in the restoring circuit after a drop has been operated, thus one reset button can be used for any annunciator, regardless of size. Each drop is a self-contained unit, and can be removed from the annunciator by disconnecting two wires and removing one machine screw. All drops are mounted on a vertical metal mounting strip which gives a rigid and substantial construction. As will be seen by one of the cuts herewith, all parts including drops, bell and reset buttons are mounted on the back board so that when the front of the cabinet is removed, they are accessible in their working condition. This is an ideal arrangement for the contractor. All drops are wired to terminals on the back board with machine binding screws for connecting to line wires. The reset button is also wired to two terminals so that an extension reset button may be used, if so desired. The company claim this outfit occupies less space than most other drops and the current consumption is extremely small. Another very interesting feature is the fact that if the glass is broken it will not necessitate remarking the drops, for the reason that the marking is done on a well finished ferrotype plate and the glass is placed over the same.

Type S Annunciator

Cover Removed

New Appleton Equipments

The fitting illustrated in Fig. 1 herewith, is a new "Unilet" conduit box. This is a combination cut-out and snap switch unilet, double-pole, 250 volt, manufactured by the Appleton Electric Company. This fitting is particularly adapted for use on machines which are operated by individual motors.

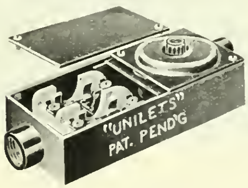
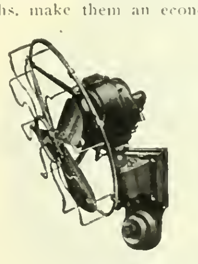


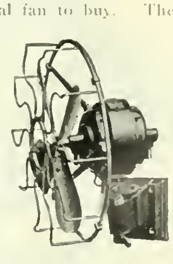
Fig. 1

Fig. 2

The fitting illustrated in Fig. 2 is a new vapor-proof "Unilet" manufactured by the same company. This fitting will be found very valuable where the lamps are subject to severe weather conditions, dampness, etc.

The Westinghouse Electric & Manufacturing Company have introduced modifications of their standard fans, adapting them to railway coach use. Their drawn steel frames are characterized by grace and strength. Their quiet operation and economical use of current, and the fact that they last for years without attention, except oiling once every six months, make them an economical fan to buy. The wall mounting fans are generally mounted on the sides or ends of the car or in the smoking compartment. For places where it is desired to have the control switch at the same location as the fan these fans are supplied with a switch attached to the base, see figure.

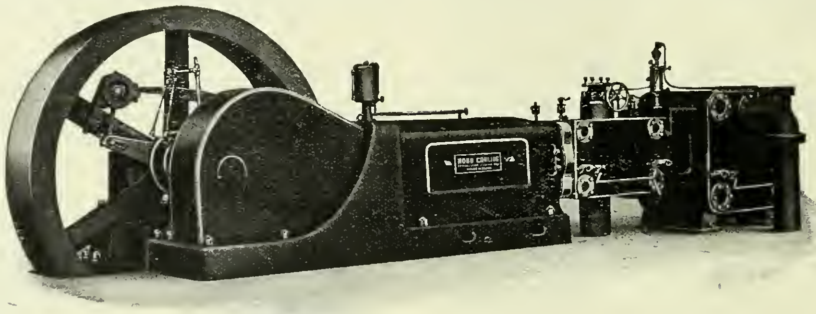




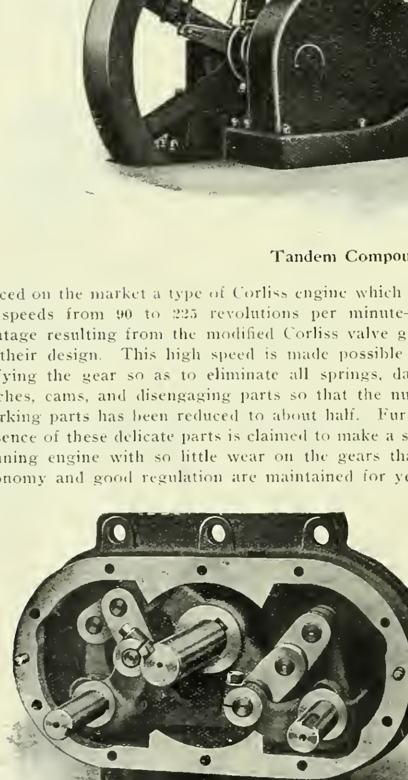
For use on electric railway cars, including subway, surface, elevated and interurban, where 500 to 600 volts is the prevailing voltage, the standard railway coach fans, without switch, wound for 220 volts are supplied with special resistor to take up the extra voltage. They have one lead grounded to prevent shock to any person coming in contact with the fan. The resistor also contains a choke coil to reduce the rush of current when the fan is first connected to the line.

Robb Corliss Engines

Many persons have hesitated to install the Corliss type of engine because its speed is too low, especially for driving a generator direct-connected. With shorter stroke, much higher speed, positive operation of valves and complete enclosure of moving parts, this type of engine, however, has been brought to overcome the above objections without any sacrifice of the usual advantages of the Corliss valve gear—almost perfect steam distribution, independent adjustment of the events of the stroke, small clearance, and separate cylinder ports for admission and exhaust which reduce cylinder condensation. The Robb Engineering Company have placed on the market a type of Corliss engine which operates at speeds from 90 to 225 revolutions per minute—an advantage resulting from the modified Corliss valve gear used in their design. This high speed is made possible by simplifying the gear so as to eliminate all springs, dash pots, latches, cams, and disengaging parts so that the number of working parts has been reduced to about half. Further, the absence of these delicate parts is claimed to make a smoother running engine with so little wear on the gears that steam economy and good regulation are maintained for years. In other respects the Robb Corliss type is designed on the lines of modern heavy duty Corliss engines. A relatively short stroke and compact substantial frame with plenty of metal in the direct line of strains overcome the vibration in the long stroke girder frame design and the reciprocating parts are carefully balanced.



Tandem Compound Robb Corliss Engine, Type "F"



Valve Gear Casing—Cover Removed

Full pressure of steam comes very quickly into the cylinder of this engine because of the triple port opening through the admission valves, and there is free exit through the exhaust valves at the proper time because of the double port opening. The steam pressure is well taken care of by the large surfaces of the valves which are nearly balanced by carrying the metal around the top; this results in a long life and a minimum wear on the valves and seats.

The valve action does not depend on a releasing gear, for quick opening and closing is the distinct feature of the Robb Corliss engine, but the action imparted to the valve is identical with that of drop cut-off gears. Two small links between the wrist plate and the valve crank do away with springs, dash pots, latches and cams, making a positively driven valve gear which may be operated at high speed. The valve gear is positive, that is, it does not let go of the valves, but, with positive action, opens them quickly, closes them promptly, and holds them stationary during the closed period which is half the time and constitutes that period when the unbalanced pressure between the steam pipe and the cylinder would cause friction. Enclosing the valve gear in a tight casing so that all working parts are in a bath of oil reduces to a minimum friction and wear so detrimental to releasing gears.

It is further claimed that a more desirable and economical steam distribution is possible with the double eccentric arrangement, as it permits of an independent setting of exhaust valves for release and compression. Two eccentrics are used in the Robb-Corliss engine, one forming a part of the governor and controlling the steam valves and the other operating the exhaust valves.

The cut-off is controlled direct by a governor which is a modification and improvement on the Sweet's shaft governor. It is located in the fly wheel of the engine and drives the valve gear and controls its operation. Simplicity and power are combined in this governor by reducing the number of main parts to three and carrying the centrifugal weight upon a spring entirely independent of any bearings.

The moving parts of the engine are completely enclosed, affording ample protection and cleanliness. The bed castings are so arranged that the oil is retained and carried to the crank pit and from this point, distributed to all the bearings of the engine by means of an oil pump. Positive lubrication is thus assured although as an additional safeguard an oil reservoir is mounted on top of the engine, ready for immediate use. Cylinder lubrication is provided by a sight feed lubricator and by a positively-operated power pump with oil pipes leading to the cylinder at the proper points.

The reciprocating parts of the engine are balanced by properly counterweighting the cranks and setting the valves to give correct compression to cushion the reciprocating parts at the ends of the stroke.

Current News and Notes

Ancaster, Ont.

A deputation from the village of Ancaster interviewed the Hon. Adam Beck with reference to a supply of power.

Calgary, Alta.

The contract for steel valves and fittings for the new power plant has been awarded to the General Supplies Limited, Calgary.

A filtration plant and pumping station with daily capacity of 10,000,000 gallons is being discussed.

Forest, Ont.

The town of Forest recently purchased the plant of the Hamilton and Prout Electric Light Company, by expropriation, and are now building a new power station near the town hall. They will use the same generating equipment, and transfer it to their new building. The distribution system, however, will be extended, and concrete poles installed, similar to those now in use in Toronto. The street will be illuminated with 100 watt tungstens, in series, installed on brackets on the poles. The generating equipment consists of a 70 kv.a. Westinghouse unit. This was reported in our September 1st issue as being new equipment, but, as stated above, it is only a transfer from the old power house. Mr H. A. MacLean, town engineer of Sarnia, is supervising the work.

Fort Frances, Ont.

The by-law authorizing the payment of $5,000 for the private telephone system has been passed. It has been said that the system will be reconstructed, and an attempt made to lower the rates.

Fort Henry, Ont.

It is said that work will start, in the near future, on a wireless telegraph station at this point. The work will be carried on by the Department of Marine & Fisheries of the Dominion Government.

Fort William, Ont.

At the last meeting of the City Council it was decided that all efforts possible would be made to have the street railway extensions across the Kaministiquia river to Island No. 2, completed and in operation before the end of the present year, which will be a great accommodation for the many workmen employed on the various industries in this locality.

The city of Fort William will take over their end of the electric railway this coming fall. Heretofore the city of Port Arthur has controlled the street railway under a joint board, made up of representatives from both cities. Formal steps have already been taken in connection with the operation of an interchange service, between the two cities. It is not thought that there will be any material change in the service, except that cars will run at shorter intervals.

Galt, Ont.

The illumination of Jackson Park, by ornamental standard clusters is being considered.

Goderich, Ont.

The municipality has purchased sixty Jandus Luxolabra, three and one light, ornamental standards, which will be installed around Court House Park.

The Goderich Board of Trade has been discussing the construction of a number of interurban electric lines, and the Hydro Commission may be asked to report on the matter.

Hamilton, Ont.

The contract has been awarded to Mr G. M. Gest, for the construction of Hamilton's underground conduit system. The total cost will be in the neighborhood of $1,750. Somewhat less than half of this will be borne by the city, private companies in Hamilton paying the balance.

The Hamilton Street Railway Company have placed in operation their new Barton street extension, and the cars are now running through to Kenilworth avenue.

Inglewood, Ont.

The Shale Products Limited, of Inglewood, Ont., have just completed the installation of a power transmission line, from their water power plant to their brick plant, a distance of about one mile. The water plant consists of a 70 inch Barber wheel, operating under a 10 ft. head, which drives a 125 kv.a. Westinghouse 2300 volt, 25 cycle, 3-phase generator. Motor equipment at the brick plant includes two units operating at 2200 volts, and two smaller units at 550 volts. Mr. T. H. Graham is president.

Kingston, Ont.

Tenders are called up to September 15 for the supply and installation of approximately 20,000 duct feet of conduit. Mr. C. C. Folger is general manager of the Light, Heat and Power Department.

London, Ont.

It is now said a vote will be taken during the early part of October on the question of the electrification of the London & Port Stanley Railway.

Lindsay, Ont

On September 3 a by-law carried, by a large majority, authorizing a contract with the Electric Power Company to illuminate the streets of the city. Magnetite arcs will be used on the main street. Mounted on ornamental standards. Service wires for the arc lamps will be underground.

Minett, Ont.

The Cleveland House Hotel have installed a Lister Bruston automatic electric lighting plant to do their lighting and pumping. The plant was supplied and installed by the R. A. Lister Co., Ltd., Toronto, Ont.

Montreal, Que.

Following their policy of constantly renewing their permanent way, the Montreal Tramways Company are putting in new intersections at the principal points of the system. The rails are much heavier, and the roadbed is also of a more substantial character.

The stock of poles and wires of the Merchants' Telephone Company, Montreal, which went into liquidation a few months ago, has been purchased by the Bell Telephone Company. The stock will be utilized in the construction of new lines by the Bell Telephone Company.

Business in the electrical trade has been dull for some time, and some of the larger companies have laid off men. There are indications, however, of a revival and prospects are good for a satisfactory fall trade.

A Federal charter has been obtained for the Southern Canada Power Company, Limited, with the head office in Montreal. The company have power to carry on operations throughout Canada as a light, heat and power company, and to produce and convert heat, light and power from hydraulic,

pneumatic or other energy or from gas or otherwise, "provided, however, that any sale, distribution or transmission of electric, hydraulic of other power or force shall be subject to local and municipal regulations."

New Westminster, B.C.

The city of Westminster has purchased a 150 h.p. electric hoist, for operating a clam shell bucket on a derrick. The hoist has three drums, arranged according to "the waterfall" type, and is also equipped with a Clyde "Type A" bull-wheel swinger. The 150 h.p. motor is a 3-phase, 60 cycle, 220 volts induction motor with outboard bearing bolted to bed extension. It develops 720-700 revolutions per minute. The controller has a contractor panel which automatically throws in the resistance, making it impossible to start the motor above a safe speed. The outfit was made by the Clyde Iron Works, of Duluth, for Messrs. Taylor & Young, Vancouver, from whom it was ordered by the city of New Westminster.

North Bay, Ont.

A telephone despatching system has just been placed in operation over the T. & N. O. Railway lines.

Ottawa, Ont.

The contract for supplying the municipal electric commission of Ottawa with 47,698 feet of paper insulated, 3-core, lead covered, 3,300 volt cable, has been awarded to the Imperial Wire and Cable Company, of Montreal. The Canadian Westinghouse Company have also been given a contract by the commission for the supply of regulators for $16,935 and the Canadian British Insulated Company will supply 1,098 feet of armored cable for $752.13. The insulated cable is for the new underground mains that the commission proposes to put in, thus doing away with the overhead wires.

Port Carling, Ont.

Dr. Ellen Burt Sherratt has installed a Lister-Bruston automatic electric lighting plant at Ewa Yea, her summer home. The equipment was supplied by the R. A. Lister Company, Limited.

Prince Albert, Sask.

The cost of the municipal hydro-electric scheme is said to be running into much larger figures than was originally estimated. The work has been held up in the meantime and C. H. & P. H. Mitchell, consulting engineers for the city, have been asked to report again on the probable total cost.

Regina, Sask.

A new pumping unit of 5,000,000 gal. capacity has been recommended by Commissioner L. A. Thornton.

An extension of the ornamental street lighting system is under consideration.

The developments of the past six years in the municipally owned public utilities in Regina are exemplified by the increasing surplus as shown in the power plant department. In 1912 this was $71,200, as compared with $20,833 in 1907. This is in the face of a reduction in price from 25 cents per kw.h. to from 7c to 1¾c. In special cases a 1c rate is given. Regina is at present building a $425,000 power house and is spending a further $250,000 in power and light extensions.

Souris, Man.

A by-law was passed on September 2nd, authorizing the expenditure of $40,000 on an electric light and power plant.

Sault Ste. Marie, Ont.

A fire at the power house of the Lake Superior Corporation on August 25 put the plant temporarily out of commission.

Smith's Falls, Ont.

The Smith's Falls Electric Light Company, Limited, are doing away with their old 133 cycle single phase lighting system, and are installing a Westinghouse 275 kw., 3-phase, 60 cycle generator for lighting and power. The water wheels are being rearranged so that there will be three 300 h.p. wheels belted to the line shaft, to which also a new Goldie & McCulloch 500 h.p. high speed, steam auxiliary can be coupled for peak requirements. The transmission lines are also being altered considerably to take care of the new system. Mr. Geo. B. Frost is general manager.

St. John, N.B.

Negotiations are still underway between the street railway company and the city council regarding line extensions to Kane's Corners.

Sydney, N.S.

Gross earnings of the Cape Breton Electric Company for the year ending June 30, 1913, amounted to $373,788, an increase of $27,350 over 1912. The gain in net was $18,052. The Cape Breton Electric Company controls the entire electric railway and lighting business of Sydney, N.S., the ferry business between Sydney and North Sydney, and an interurban line between North Sydney and Sydney Mines. It also controls the Sydney and Glace Bay Railway Company.

Toronto, Ont.

The Civic Transportation Committee have advised the creation of a Metropolitan area with an approximate radius of twenty miles, to be under the supervision of a Commission of three. The Commission would include (1) an electrical, (2) a road and parks, and (3) a health commissioner.

The Hydro-electric Power Commission have started work on the extension of the step-down transforming station at the foot of Strachan avenue.

Truro, N.S.

The town council have decided on the installation of a municipal electric plant and will require generators, and all necessary auxiliary equipment as well as a complete equipment for ornamental standard street lighting.

Vancouver, B.C.

The B. C. E. R. Company have submitted a proposition for the lighting of Saanich Municipality. The rates offered are 3½c per kw.h. if a minimum of 500 80-watt lamps is used, or 3c if 1,000 lamps are taken.

Westboro, Ont.

The Ottawa Electric Company have been awarded the contract for supplying the village of Westboro with fifty 100-watt tungsten lamps at $13 each per annum. The contract, when approved by the ratepayers on the 19th inst. will be in force for ten years. Poles for the lights have been ready for some time.

Westport, Ont.

The Westport Rural Telephone Company, Limited, has been incorporated, and will construct and maintain a small telephone system.

Winnipeg, Man.

A contract has been awarded to the Canadian Westinghouse Company for the supply of three 5,000 kv.a., 2-bearing, direct coupled type, 3-phase, 6600 volts, 7,200 alternations, 138½ r.p.m. generators.

Wolseley, Sask.

On August 27 a by-law was passed authorizing the purchase, by the town, of the plant of the Central Light & Power Company. The town will take over the plant as soon as possible and will install all the improvements that had already been recommended by the engineer in charge, viz., a 30 kw. generator immediately and a 150 h.p. producer gas equipment next year.

Yorkton, Sask.

Contract has been awarded for a new municipal telephone exchange at Yorkton, Sask., to cost $18,000, to Logan & Black, of that town.

Electrical News

Generation, Transmission and Application of Electricity

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The Society for Electrical Development

The convention of the Society for Electrical Development held at Association Island, Lake Ontario, September 3-6, was a decided triumph for the gospel of "Co-operation." Dr. Steinmetz was only one of the many to voice the sentiment that competition as an economic and industrial force is dead, and that co-operation has taken its place. The existent opinion that the process of consolidation which is so noticeable now-a-days in the various industries is destroying competition, is wrong. It is the recognition of the fact that competition is a useless waste of time and energy that has been the cause of the consolidation. In the electrical industry this has been forcibly illustrated by statistical figures which go to show that only some 15 per cent. of the possible business in the United States has been developed. In Canada the percentage would probably be even lower. It is clearly the height of folly that all the existing selling organizations should be carrying on an expensive competitive campaign for this 15 per cent. while the 85 per cent. lies dormant. It is to remedy such a state of affairs that the Society of Electrical Development has been formulated.

As further verification of the above statement of the vast undeveloped fields of electrical operation we quote the opinion of Mr. Frank A. Vanderlip, president of the National City Bank of New York, whose address before this association was calculated to emphasize the tremendous financial demands certain to be made by the electrical industry in the immediate future. Mr. Vanderlip places the weekly demand for the next five years at $8,000,000 of capital or $400,000,000 per year. This surely is a more virgin soil in which to plant a salesman's efforts, than the 15 per cent. which has long shown signs of being over-cropped to an unprofitable degree.

Electrical Securities as Investments

As president of the National City Bank of New York the expressed views of Mr. Vanderlip, before the Society of Electrical Development, on the value of electrical securities as desirable investments, were heard with satisfaction by all electrical men present. The speaker pointed first to the comparatively small percentage of investors who have in the past cared to risk anything in electrical securities. These he places at 20 per cent. or less and gives as explanation (1) the fear of some new invention upsetting all financial calculations and (2) the often unfavorable relations regarding charters, rates, taxes, etc., which exist between private companies and the municipalities in which they operate. Mr. Vanderlip added, however, that "the time has now come, in my opinion, where no man with capital to invest in corporate securities, if he has a desire for return that is any larger than government obligations will pay, can longer hold back from the study of public utility investments."

It is probable that a more opportune moment than the present has never existed in Canadian history in which to formulate a judgment on the ability of public utility securities to withstand the onslaught of hard times and tight money. In reviewing the proceedings of the stock markets for the last six months, serious recessions in the prices of electrical securities are almost conspicuous by their absence. This, too, it must be noted, is in the face of the fact that many of these industries are young and far from mature. The explanation is not far to seek. The various phases of the electrical industry, such as street railway operations, electric lighting, etc., represent, from the very nature of the service they supply, a continuity of operation and stability of revenue not found in other lines of industrial development. The electrical investor especially should bear these advantages in mind. By patronizing his own securities he will not only assist in establishing the confidence of the general public but he will reap a good financial return himself

Exhibit of Electric Trucks

A noteworthy feature of the Vancouver Exhibition parade held on the opening date, September 1st, was the electric trucks division, organized by the B. C. Electric Railway Company, at whose garage nearly all the electric vehicles owned in the city are stored. The division was led by the company's tower wagon mounted on a 1-ton chassis, followed by a fleet of trucks operated locally by this concern, comprising a demonstration truck weighing $3\frac{1}{2}$ tons; construction truck, capacity 2 tons; arc light wagon, capacity 750 pounds; and a meter wagon of 1,000 lbs. Next in order came the trucks owned by prominent Vancouver wholesale firms. These consisted of a 5-ton truck owned by Kelly Douglas & Company, wholesale grocers, which has been in constant daily operation in the city for over 5 years and is still giving satisfactory service; the Dominion Fish Company's 1-ton delivery wagon, which has been successfully operated for the last 3 years; a 1-ton truck owned by the wholesale hardware firm of McLennan, McFeely & Company; the Brackman-Ker Milling Company's 2-ton truck; a 2-ton truck operated by the Rainsford Company, wholesale fruit merchants; and a 2-ton truck in the service of Wood, Vallance & Leggat wholesale hardware merchants. Occupying a position at the rear of the division was the chassis of a 750 pound delivery rig, the works of which were purposely left uncovered to demonstrate how simple is the operation of an electric truck. All vehicles were decorated with banners advocating the economy and satisfaction which is guaranteed by the use of electric trucks.

A great deal of interest was evidenced by the general public in this display, the first of its kind to be held in Vancouver and the organizers are of the opinion that as a result

of the publicity gained, the sales of electric vehicles should be stimulated throughout the province. Among the exhibits of the B. C. Electric Company at the Vancouver exhibition was a splendidly equipped electric bus recently disposed of to the Lotus Hotel, of this city. This is the second hotel bus sold by the company since January 1st of this year, the other one having been purchased by the Dunsmuir Hotel.

Other units included in the company's exhibit were an

Electric truck parade in Vancouver.

electric pleasure vehicle manufactured by the Standard Electric Company; rotary convertor for use in charging electric vehicles in private garages; vibrating rectifier for charging ignition and lighting batteries from household circuits; an electric vulcanizer utilized in repairing automatic tires, and in addition a full line of appliances used in connection with electric vehicles.

An Encouraging Sign

A complimentary reference was made by Mr. M. B. Cotsworth in his minority report regarding the wages dispute, to both Mr. R. H. Sperling (general manager of the company) and the representatives of the employees. Mr. Cotsworth says:—"The well recognized ability and fairness of the general manager is manifest by the authority given him by the company, and the fact that during the months this dispute has been maturing, not a single detractive word has reached me from any of the hundreds of employees I have met, but on the contrary they have expressed confidence that so long as they could be assured that he had freedom to do right, they could rely upon getting justice from him, because his past decisions had been fair, whenever they were permitted to lay their cases before him personally."

"Similarly the board of conciliation was unanimously convinced of the ability and fairness of the local president of the employees' association and his henchmen, who rightly hold that the men's capital employed as personal energy is as essential to the success of the company as is the electrical energy, machinery, cars, etc., purchased by the shareholders' outlay."

Electricity in India

The conversion from steam to electric drive of a large number of cotton mills and factories by the Tata Hydro-electric Company will shortly be taken in hand. The contract for this important work has been entrusted to the British Westinghouse Company, whose staff and machinery are now due in Bombay. The motors will all be of the Westinghouse "A1F" slipring protected type, suitable for double drive, and for 3-phase current, at 2,000 volts and 50 periods. At present a total of 207 motors of this type have been ordered, the sizes ranging from 50 to 500 brake horse-power. The motor speeds are 290 and 365 revolutions per minute, there being several of each horse-power capacity at these speeds. With regard to the drive, the motors will be coupled direct to the line shaft in a great majority of cases without the intervention of counter shafting. The motor switch pillars are of the Westinghouse ironclad type "S" pattern, which are now being largely used in mining and other industrial work, the starting being effected by liquid controllers. The transformers are 3-phase, oil-immersed, self-cooled units, and reduce the supply from 6,000 to 2,000 volts kv.a. from the motor. They number 64 in all, and are of four sizes, namely, 22 of 500 kv.a., 14 of 600 kv.a., 21 of 700 kv.a., and 7 of 900 kv.a.

The Montreal Harbour Electrification

The enormous increase in the work of the Montreal Harbour Commissioners, especially by the extension of grain storage, has resulted in the greater use of electrical power. According to the report of Mr. T. E. Salter, chief electrician to the Commissioners, about 5,000 horse-power in motor load and 2,500 incandescent lights, fed from power from Nos. 2 and 3 sub-stations, were added to the system during the 1912 season.

The plant is electrically driven throughout by 3-phase 60-cycle, 550 volts, squirrel cage induction motors, the units ranging in size from 5 horse-power to 150 horse-power. No. 1 station feeds and controls for No. 1 grain elevator, 1,000 h.p.; for conveyor galleries, 1,785 h.p; No. 2 station feeds and controls for No. 2 grain elevator, 3,435 h.p.; and for conveyor galleries, 1,250 h.p., a total of 7,470 h.p. The system is lighted by approximately 2,000 incandescent lamps and 15 arc lamps.

The current is delivered by the Montreal Light, Heat & Power Company from their underground system to No. 1 station at a pressure of 2,500 volts. This is stepped down through three 300 kv.a. and two 375 kv.a. self-cooled, oil-insulated transformers for power, and through three 10 kv.a. and two 20 kv.a. self-cooled, oil-insulated transformers for 110 volts multiple and 440 volts series lighting respectively. The power is received at No. 2 station at 2,500 volts, similar to No. 1, and this is stepped down through three 1,000 kv.a. water-cooled, oil-insulated transformers for power, and through three 25 kv.a. self-cooled transformers for 220 volt multiple lighting. The main feeders are carried from the low tension switchboard to power panels located on the different floors of the elevator and in the towers of the conveyor system.

There are three distinct telephone systems in use, for No. 1 elevator, for No. 2 elevator, and for the conveyors. For the latter there is a telephone in every tower, in each shipping gallery, and one in each of the elevators and sub-stations. The tower stations consist of a standard telephone giving communication with the other towers and elevators. The gallery stations consist of a number of telephone jacks placed at ship loading spouts, and vary between 14 and 19 in different galleries. Each of the elevators has an independent signal system consisting in one case of annunciator drops and numbers, or with annunciator drops numbered, used for starting and stopping apparatus and in the other case of red, green and blue lights used for automatic weighing of grain. The conveyor galleries have a system of signals designed to operate a bell and light in series. These signal lights are numbered and correspond to the belt from which the signal is sent, signals from No. 1 elevator appearing on red globes, and signals from No. 2 elevator appearing on green globes. In order that grain from No. 1 and No. 2 elevators may not be sent on the same belt at the same time, and thus cause a grain spill, an interlocking system is installed in this portion of the conveyors, and, acting through a system of relays and push-buttons, prevents the

energizing of the signals from any other source than the first given. These remain set until the shipment is complete and the line restored to normal position.

An underground system carrying power and light cables has been commenced from Victoria Pier and a number of ornamental arc lamp standards have been erected on the high level wall on Victoria Pier and also between Victor and Berri Street subways. Current is supplied from No. 2 Station for these arc lamps as well as for the lighting up of the subways. These lamps are of the regenerative yellow flaming type, of about 2,500 candle power each.

The new wharf offices situated on the west side of No. 1 elevator are equipped with fittings mostly of the pendant chain type, with a few 4-light fixtures where occasion required, the halls and porches being fitted with the opalescent ceiling type. The offices are illuminated with 40 and 60 watt tungsten lamps, current being supplied from an underground circuit fed from No. 1 station, which enters the main distributing panel in the basement of the offices. Railway companies who have leased offices in the same building, are also supplied with the same current through separate meters. The total power consumed and the cost of same during 1911 and 1912 in No. 1 elevator were:

Year	Total Power Consumed	Cost
1911	981,399 h.p. hours	$15,241.61
1912	1,011,572 h.p. hours	15,285.92

During the present year No. 2 elevator has been constructed, and the electrical equipment has been described in the Electrical News. An addition to No. 1 elevator is now in process of being built, and this will necessitate an addition to the transformer station and plant and its re-organization. This work, however, will not be carried out completely until the close of navigation.

Flexible Frame Tower Line

Transmitting Power from Decew Falls to Bartonville, Hamilton

By Mr. C. H. Hutton

The first flexible "A" frame transmission line to be built in Canada has now been in successful operation for a year's time. This interesting line, forming a part of the extensive 45,000 volt transmission system of the Dominion Power & Transmission Company of Hamilton, Ont., is 31.6 miles in length, and is one of three main trunk lines connecting the open air switching station at Bartonville with the generating station at Decew Falls.

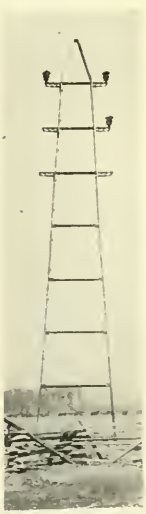


Fig. 1.—Typical tower.

Since the completion of the main line this company has built several shorter lines using the same construction. The line is built on a private right of way 33 feet wide, for the greater part paralleling concession roads or railways. This has proved an immense advantage, both in construction and for patrol purposes. One triangle only is strung at present, there being room for two ultimately on the one tower line, and room on the right of way for two lines.

An excellent idea of the neat appearance of this type of construction is had by referring to figures 1 and 2 which show a portion of the line where it parallels the Toronto, Hamilton & Buffalo Railway. As will be seen, the tower has only two legs, each of which is composed of standard 7 in. No. 9.75 channel. The legs are in one piece and are connected together by a system of 5/8 in. round bar latticing and 2¼ x 2¼ x ¼ angles, so that there is no thin metal whatever, and hence no need for the customary and expensive galvanizing. The sides are slightly curved, giving the tower a very graceful appearance. The arms are malleable

Fig. 2.—Special 57 'A' frame towers.

castings bolted to the 7 in. channels, as are the steps on one side.

The footings are composed of two pieces of channel placed at right angles, clearly shown in Fig. 1; the upright piece or stub is heavily galvanized notwithstanding its thick section being 8 in. No. 11.25. The footing is carried well above the ground line so that the tower possesses maximum section and resistance to corrosion at this vital point. The towers are shipped from the factory assembled complete, with the exception of the arms, 12 on a flat car. This is an immense advantage, as all joints are rivetted at the shop,

Fig. 3.—Motor made 12 trips daily, 4 towers each trip.

and all field work in assembling done away with beyond the bolting of the arms and steps in place. At corners and for railway crossings towers of identical construction but heavier section were used. These towers, and one every half mile on tangents, were guyed to scrap rail anchors buried 6 feet deep in the earth. Suspension strain insulators, as well as the ordinary pin insulator, were used on these structures as may be seen in Fig. 4. Two split lock nut washers were used on the insulator bolts, one at each end. These proved great time savers in aligning the insulator grooves with the conductor.

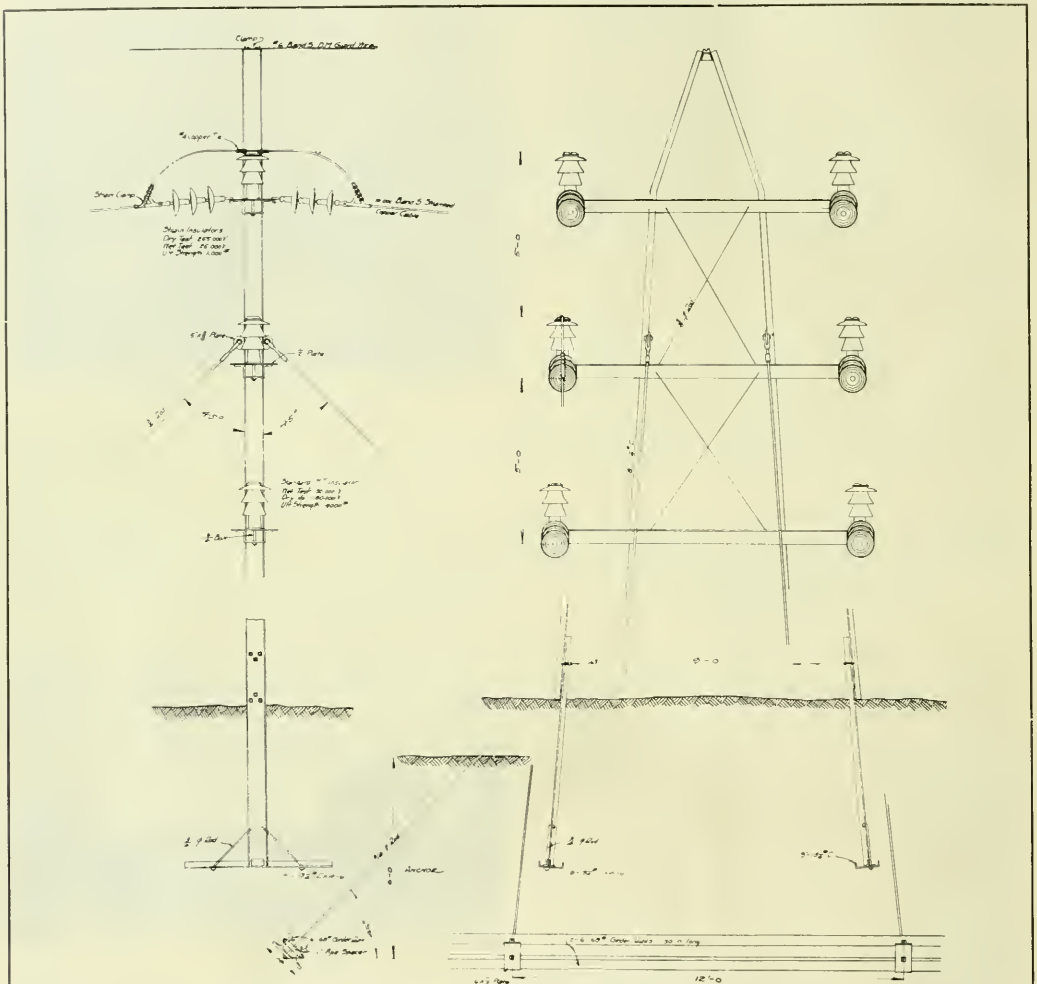
The speed of erection of the towers was a revelation to many who were familiar only with the length of time taken

to assemble and raise the old style 4-leg windmill type of structure. Some idea, however, can be gained when it is stated that an erection gang composed of 1 team and 6 men on average ground could erect 4 towers an hour with ease. When a tower was erected it meant that it was ready for the copper, as the insulators, arms, etc., were all placed and adjusted before raising.

The delivery of all material was accomplished by auto truck and some towers raised by this means. Fig. 3 shows the truck equipped with trailer hauling 4 standard 47 ft. towers from the railway delivery station. The truck was worked day and night and made an average of twelve trips a day with 4 towers to a trip, the longest haul on the line being 12 miles from the railway. The truck was purchased for this job and sold at its completion, paying for itself and showing a handsome profit on the transportation estimates.

The conductors are composed of six No. 6 B & S gauge, M. H. D. copper strands around a hemp core, and are pulled up to an 11 ft. sag in standard spans of 400 feet between towers. The longest span on the line is 750 feet, where the line goes up the Niagara escarpment some 250 feet. The construction proper commenced June 1st, 1912, and the line was in service the following November.

From carefully prepared estimated and actual construction costs, the relative economy of this type of line compared with 4-leg towers of equal weight, is as follows:



Sectional plan showing towers, insulators, strain insulators, footings, etc.

	4-Leg	"A" Frame
Cost of towers on cars	100%	85.7%
Sub-delivery	100%	93%
Assembling	100%	6%
Foundation	100%	62%
Erecting	100%	19.5%
Stringing	100%	115%

The line was built complete under the supervision and direction of the company's own engineering staff and construction department. The various contracting firms were

as follows.—towers, Archbold-Brady Company, Syracuse; foundations, Hamilton Bridge Works Company; insulators, Thomas Insulator Company; strain insulators, Ohio Brass Company; hardware, Ohio Brass Company; brackets, McKinnon Dash Company, St. Catharines; motor truck, Monarch Motor Car Company, Hamilton; conductors, Standard Underground Cable Company, Hamilton; Eugene F. Phillips Company, Montreal; graphite paint, Dominion Paint Works, Limited, Walkerville.

Central Station Opportunities

The Electric Vehicle the Greatest Paper before N. E. L. A. Convention

By Mr. E. E. Witherby

The biggest piece of real business in every man's community in the transportation of persons and merchandise and at least fifty per cent. of all the tonnage that you see every day can be hauled cheaper by electric vehicles than it can be done by horses or gasoline machines.

The pleasure car salesman has a hard up-hill job to convince the man or woman who wants a simple and elegant vehicle for personal use, to buy an electric. The electric truck salesman has a hard job to influence the merchant or warehouseman in the purchase of electric commercial vehicles, when the officers and superintendent of the electric company are all driving around in gas cars and are using horses and gas trucks for the work of the central stations. And, let me emphasize the fact that this is not an idle statement; on the other hand, it is the usual condition, I am sorry to say. Now, I am not taking every central station man to task on this—there are a few who realize the opportunity and are honestly trying to help the electric vehicle and in this way help themselves for a big record of increase in business and their stockholders to dividends; but the small percentage of the whole who are helping is what hurts us all,—I honestly believe they total less than ten per cent. of all central station men.

High class engineers have for years worked to produce apparatus that will give great economies. This is more true in the electric field than any other class of engineering and they have accomplished something, but the greatest economy has been brought about not so much by change in design as by larger units and better load-factor. In the old days, electric stations operated from dusk in the afternoon until one a.m., or perhaps until daylight, with a load-factor of 5 to 6 per cent. A little later we ran our plants twenty-four hours a day, and with a combined railroad and lighting plant we had a load-factor of perhaps 25 per cent. and sold current at 20 cents a kw.h. Now the universal power in small establishments is the electric motor. Domestic appliances are everywhere. Our generating units have gone from 37½ and 50 kw. to 15,000 or 20,000 kw. and now we are soon to see one of 30,000 kw. installed in the city of Chicago. Load-factor is being improved constantly. We are all looking for the ideal 100 per cent. and our chances are good,—but how? Most of our power motors are cutting out about five or six p.m. and starting at seven or eight a.m. Our regular residence and commercial load is off the lines by midnight (except in New York); but we cannot turn night into day everywhere and we cannot expect to see the time when all factories will work nights as well as days, for men will not do it. What we must get is a load from ten, eleven and twelve o'clock at night until seven in the morning, and the electric vehicle is the one thing to do it and give the load necessary to flatten out the load curve.

The electric vehicle salesman has convinced thousands of ladies that the electric pleasure car is what they want—the central station man did not do it—and thousands of these vehicles are in use today and are here to stay. The electric truck salesman has convinced hundreds of up-to-date merchants and manufacturing companies. The result is that thousands of electric trucks are in daily use and they work every workday. These salesmen have increased the revenue of electric light and power companies thousands of dollars annually. Now what co-operation and help do we get from the average central station man? I say, emphatically, not a particle. We thank our lucky stars there are some exceptions and the exceptions are the ones that are now getting the greatest return for their help and assistance given when we needed it most.

In the city of Chicago there were in use:

November, 1910, 80 electric commercial trucks.
November, 1911, 150 electric commercial trucks.
April, 1912, 263 electric commercial trucks.
November, 1912, 365 electric commercial trucks.
January, 1913, 523 electric commercial trucks.
May, 1913, 647 electric commercial trucks.

And, as the saying is, "that's going some," and the live combinations in this city are hoping for a thousand by December 31, 1913. While some of us are working for trucks all the time, some others are just as hard at work on pleasure cars. While the pleasure car is exceedingly popular with the ladies, the business man is putting it to a broader use to meet his requirements around the city, for the electric is the only real practical car for city use.

Some ten years ago, I was the owner of a couple of electric cars, a runabout and a surrey, and being a central station man, supposed I should know all about them because they were electric. I had a lot to learn and it was expensive. Current for charging cost 15 cents per kw.h. at first, and later 12 cents, and today, in most places, you pay 10 cents, if you keep your car at home. But in Chicago, in public garages, you pay from 2 to 6 cents, depending on quantity.

Chicago electric interests have been in favor of electric vehicles for years and are using them to the exclusion of other types of vehicles. Boston has always been a strong advocate. Philadelphia and St. Louis have pushed the electric vehicle constantly, and recently the New York Edison Company has come very strongly to the front in pushing the electric vehicle, and today in New York City we have nearly 3,000 electric trucks.

The big express companies, the American, Adams, Wells Fargo and others, after a try-out of gasoline versus electric cars, go in strongly for the electric car for city service, and it is no experiment with the express companies. Extensive investigation and careful checking of results, were what determined the final decision. In five years there will be thousands of electric trucks in this one service. Now, tell me, why should the electric light and power man hesitate as he is doing at this time?

Some of the largest fleets are in the brewery interests, one brewery in New York having 112 electric trucks of large capacity—all of one manufacture, and the breweries have not gone into this in a wholesale way without a try-out. They have taken years to test it out. The result is that a representative of one of the largest breweries in New York made a public statement at the Brewers' Congress in Boston, Mass., October, 1912, that the electric trucks were saving his company over $80,000 per annum in delivery service.

The electric light company in New York did not sell the brewery company that lot of trucks. It was a matter of indifference to them at the beginning, but not so now. Today the electric light company is on the job every minute, and employs some of the brightest brains and business talent in the country to push the sale and use of electric trucks and pleasure vehicles.

Now, if this is good business for New York, Chicago,

Boston, Philadelphia, St. Louis, and some of the larger cities, why is it not equally important to every one of you who manage or who are responsible for a generating plant and really interested in its success?

Wherever you find a Doherty company you will find every man on the job pushing electric vehicles and, what is best of all, this company is using them at every point. That organization practises what it preaches. I wish all of you were as consistent.

Hartford, Conn., has also become an agent for a prominent truck and is selling current by the can, as it were, on a flat mileage rate and apparently it is a big success.

We could go on and mention a number of others but that is not the point I am aiming at. What I want you all to realize is that I am directly after the manager, the "New Business Man," the chap who is actually responsible for the sale of current of every company in this great country of ours. I wonder if the managers of all operating companies realize that the new business man, the real business getter, is more responsible for reducing costs and increasing revenue than the engineer at the plant in 75 per cent. of the operating companies of today.

It is easy to figure what flatirons, cooking and heating appliances and many other things are going to do to help our load-factor. Motors for power, while long hour business, lap over and increase peak and in a great many cases increase investment charges, but current for charging electric vehicles is off-peak business.

Because I was in the operating end for over twenty years is the reason I am now reading this paper. I feel that I can see both sides of the question and I know that more than 60 per cent. of the men in charge of properties will not do the first thing to help push the electric vehicle. I know of one place where an express company installed some electric trucks but in a few months had to take them away and send them to some other city, because they could not get anyone in the city to take care of them properly, yet the electric light and power company in that city is supposed to be up to date in every way. I might add that this company uses gas cars for their own work.

Only last week one of our salesmen wrote from a good-sized city in Ohio as follows: "Mr. W., secretary and treasurer of this company, recently bought a gas truck. He said he had heard a lot about electric trucks but they had been afraid to install the same, thinking the electric railway, light and power company would have electrics if they were economical and reliable." Gentlemen, this is the example over again. Practise what you preach.

Some of our central station men say that the electric truck is too heavy and will not do their work, that it takes too much power to move itself; they do not stop to check up that 5-ton electric truck, with an up-to-date battery, will weigh less than a 5-ton standard make gas truck, but it is a fact. That same man will approve of an electric pleasure car that is so built and arranged that it is only carrying one pound of load for every eight to ten pounds of vehicle, while he will hesitate to use or advocate the lighter capacity electric trucks where we have one pound of load for every four pounds of vehicle; and on the 5-ton electric truck we just about balance a pound of load for a pound of complete vehicle, so when we come to real efficiency, we excel in the larger capacities. And 5-ton trucks will use current on an average, if worked to full capacity of load and mileage, 900 kw.h. per month or 10,800 kw.h. per annum, or in round figures $450.00 to $500.00 per annum current cost. Now, suppose you have one hundred 5-ton trucks in your city at $500 per annum, that means $50,000 added to off-peak business without a dollar of increase in investment, no more for labor or depreciation, only added cost of coal, water and oil. This, I believe, proves what I have said at the start. You are overlooking the one best and biggest thing that it is possible to get.

When the time arrives that it is impossible for a central station manager to see a wagon load of merchandise passing on the street without mentally translating the impression into terms of dollars and cents of revenue from off-peak load, then he will get busy on promoting electric vehicle activities. At the present time most of you are travelling in the rut of old methods and this business is going by you in streams every day without suggesting to you that it is and should be your business.

In 1910, the railways transported, exclusive of duplication, 1,026,491,782 tons.

It would be interesting to know just what percentage of the total tonnage was of necessity hauled to and from freight terminals, possibly 25 per cent. of it was trucked twice, perhaps four times, between the point of original shipment and ultimate destination.

Suppose you should translate these possible ton miles of truck hauling into terms of kw.h. and then into dollars of revenue. The amount would seem like a dream, but it is a possibility and it is slowly but surely coming. Now, let us all try to get some of that revenue while we are here, not leave all of it to the future generation.

The electric vehicle salesman or the manufacturing company he is working for cannot do it all. We have convinced the live merchant, the big express companies, the entire brewery industry, but the average Central station man is still to be shown the light of day.

Personal

Mr. K. L. Aitken, formerly general manager of the Toronto Hydro-electric System, has returned from Europe and will resume his practice as consulting engineer. Temporarily, letters may be addressed in care of the Toronto Hydro-electric System, 226 Yonge street, Toronto.

Mr. E. A. Ablett, manager of the Siemens Company of Canada, Limited, Montreal, is on his way to the Pacific Coast, for the purpose of visiting the electric winder installation at the Canadian Collieries, Vancouver, and also inspecting other plants in the west supplied by the Siemens Company. He will be away about seven weeks.

Mr. A. T. Goward, Victoria manager of the B. C. Electric Railway Company, accompanied by Mrs. Goward, recently left on an extended visit to England, where they will spend several months. While in London Mr. Goward will discuss with the directors matters pertaining to the company's undertakings in Victoria and immediate vicinity.

Mr. H. W. Curling has recently arrived in Canada to assume the position of managing director of the Canadian Union Electric Company. Mr. Curling comes but recently from South Africa, where for over three years he has been directing the operations of the Union Electric Company of London. During that period the many installations he supervised for them included the complete equipment of the plant and power lines for the Roodepoort Marisburg municipality; also the heating, lighting and power installation for the Rand Daily Mails.

Mr. W. G. Chace, of the firm of Smith, Kerry & Chace, who was construction engineer for the city of Winnipeg in the building of the municipal power plant, spent a week in that city lately on general business. Since leaving Winnipeg over a year ago, Mr. Chace has had charge of several large electrical and power installations for his firm in the United States. Last winter he was at Boise, Idaho, where he installed a big power plant for the pumping of water for an irrigation scheme.

High Voltage Transmission Systems*

A Review of their Electrical and Mechanical Design with Special Reference to the Equipment of the Shawinigan Water and Power Company

By Mr. Julian C. Smith

The subject of this paper is the design of a high voltage transmission line supported on steel towers. It will be considered in three sections, electrical design, mechanical design and the legal or public aspect of the problem.

ELECTRICAL DESIGN

The first point to be determined is the voltage required at the receiver end of the line in order to deliver the required amount of power with suitable regulation.

As the distances of transmission have been increased, the delivered voltage has been raised, till at present the use of 110,000 volts has become quite common and a few lines are either in operation or planned using considerably higher voltages than this.

In a new installation the delivered voltage may be determined with relation to the economic requirements or the state of the art.

The cost of all transformer equipment, switching apparatus, lightning arresters, etc., increases very rapidly with increased voltages above 100,000 volts. The transmission line must therefore be a very long one and the amount of power large to justify a delivered voltage in excess of 100,000 volts.

The frequency is also an important factor in the determination of the delivered voltage. The regulation of the line is a function of the frequency as well as of the current, and so it is not necessary to use so high a voltage for 25 cycles as for 60 cycles, if the regulation is the determining element.

In the opinion of the writer there does not seem to be any good reason for using any delivered voltage between 60,000 volts and 100,000 volts, unless there are existing conditions at the point of delivery, which have a bearing on this subject.

Having decided on the delivered voltage, the voltage required at the generating station can be determined by combining the impedence drop in the line with the delivered voltage. The generator voltage is usually higher that the delivered voltage, but with long lines and high voltages at no load, the charging current of the line may cause the delivered voltage to rise considerably above the generator voltage. For example, on the line between Shawinigan Falls and Montreal, the voltage at no load is 2 per cent. higher in Montreal than at Shawinigan Falls.

The methods of computing the regulation of transmission lines will not be treated here. The simple method, in which the capacity of the line is considered to be concentrated at the centre, is satisfactory for lines up to 75 miles in length with voltages up to 100,000 volts at 60 cycles. For longer lines using higher voltages it is necessary to take account of the fact that the capacity is distributed over the whole length of the line and that the charging current varies from a maximum at the generator end of the line to zero at the receiver end.

The calculations involving the use of hyperbolic functions are comparatively simple and give the exact result with about the same amount of computation as in the simplified methods.

> [Attention was here drawn by the author to a regulation diagram, showing the voltage required at the power station under different conditions of load and power factor. This diagram, which was based on the well known Mershon diagram, exhibited clearly the very great effect that the power factor of the delivered load had upon the regulation of the system and therefore upon the voltage required at the power station. It was also shown by diagram, that at no load a delivered voltage of 81,000 volts requires at the power station a voltage of 78,000 volts. Assuming then a load of 10,000 kw. delivered at 81,000 volts, the voltage required at the power house with unity power factor load would be 85,000 volts, a difference of 4.94 per cent. of delivered voltage. At 90 per cent. power factor the voltage drop would be 15.5 per cent., at 80 per cent. power factor 21.6 per cent. and at 75 per cent. power factor 24 per cent. (including transformer drop). These calculations were based upon a frequency of 60 cycles. If 25 cycles were used, conditions would be very materially improved as regards regulation, and therefore the power could be transmitted over a greater distance or a better regulation could be obtained.]

At the present time in the United States and Canada, there are only two standard frequencies, 25 cycles and 60 cycles. When discussing the choice of frequency it is important to bear in mind the effect the power factor has on the regulation. A frequency of 60 cycles is preferable for most cases, but if the power factor is low the lower frequency becomes of more importance.

In the question of choice of frequency, a number of points in design are involved, among them being the relative cost of 25 cycle and 60 cycle generators and transformers, and the relative performance of 25 cycle and 60 cycle apparatus.

In general, for the same capacity, the 25 cycle apparatus weighs 25 to 50 per cent. more and the cost is proportionately higher.

From the operating standpoint, 25 cycle induction motors are generally conceded to be somewhat superior to 60 cycle motors, as they are more efficient and give better power factor. It is easier to obtain low speeds with 25 cycle apparatus than with 60 cycle, as it is impossible to get more than a certain number of poles in a given circumference. Therefore, for a given diameter the speed of a machine is considerably higher with 60 cycle current than with 25 cycle current.

For railway purposes and the supply of rotary converters, the use of 25 cycles has certain advantages.

Sixty cycle rotaries cannot be built in as large sizes as the 25 cycle machines. The largest 60 cycle rotary which can be built is perhaps about 2,500 kw., while 25 cycle rotaries can be built in units of twice this size.

A 25 cycle rotary is more efficient and has better operating characteristics than a 60 cycle machine and is not so likely to flash over.

For ordinary street railway service however, there is so much discussion at the present time as to whether rotary converters are preferable to motor generator sets, that a full discussion of this matter would be a paper in itself.

The question of frequency however is involved with the question of charging current on the transmission line. This charging current, as mentioned above, is a function of the voltage, the frequency, and of the capacity of the transmission line. At 60 cycles therefore the charging current

*Presented before the Can. Soc. C. E.

at the power station is two and four-tenths times as much as at 25 cycles.

A few years ago the charging current was thought to be a source of trouble and danger in the design of a power system. With small units used for the generation of power and long lines for the transmission, it is possible to obtain such a large charging current that the generators in the power station are overloaded. For example on the transmission line from Shawinigan Falls to Montreal, the charging current at normal voltage is about 25 amperes and this is equivalent to about 4,000 kv.a., one-quarter the capacity of one unit.

If the system can be designed completely, including the design of the power station, with a knowledge of the load, the charging current of the transmission line may be utilized as an advantage rather than the opposite.

On examining the curves of the voltage and the current on the line from Shawinigan Falls it will be noted that the current at no load, that is, the charging current, varies from zero at the Montreal end to about 25 amperes at the Shawinigan end. It will also be noted that the power current, that is, the current in the wires, when full load is being delivered in Montreal, varies from 99.5 amperes at the Montreal end to 88 amperes at the Shawinigan end. This decrease in the current is due to the fact that the charging current is out of phase and in advance of the power current, and therefore compensates to some extent the lagging component of the power current. On account of this condition, the power factor at Shawinigan Falls on the high tension side of the transmission line is 8.7 per cent. higher than on the high tension side in Montreal.

From the charts which have already been shown, it is evident that the power factor of the load has a very important effect on the design of the transmission line. The charging current of the transmission line helps matters out by improving the power factor on the generators to some extent. To counterbalance the charging current of the line, there is the magnetizing current of the transformers. If these transformers are designed for large reactance, and are made with silicon steel, the magnetizing current will be between 3 and 10 per cent. of the full load current. For practical purposes the full amount of this magnetizing current of both step up and step down transformers may be considered as opposing the charging current.

As the charging current varies with the voltage and length of the line, and the magnetizing current varies as the size of the transformers and inversely as the voltage, each case must be worked out separately. Only a general statement can be made that usually the magnetizing current does not make a very considerable difference.

The efficiency of transmission is the ratio between the amount of energy delivered to the amount of energy generated. We can deal with the all day efficiency so called, or with the efficiency under maximum load conditions. The all day efficiency is important in considering the effect of coal burned in a steam plant, or in considering the amount of water stored in a water power plant in which there is a certain amount of storage of water at the power development. Both of these efficiencies have an important bearing on the cost and the size of the machinery and transmission line. The efficiency of the line itself depends principally upon the size of the conductor. So long as the voltage is kept below what is now termed critical voltage, there is no corona loss, and the only loss of energy in the transmission line is that due to the heat generated in the conductor, and possibly a certain amount of energy used up in the insulation surrounding the line.

Unfortunately the designing of transmission lines to-day cannot be based altogether upon economic grounds as regards the best efficiencies. The size of the conductor is determined to a considerable extent by other considerations than the amount of energy loss.

For example, the writer would refer to curves, which are shown later in this discussion, representing the enormous losses with certain sizes of wires at the higher voltage.

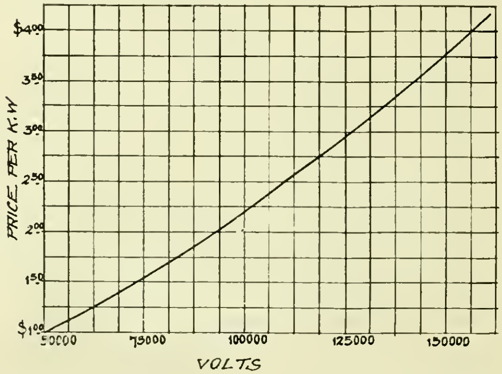
It is evident that if one desired to transmit power at 200,000 volts, it would be necessary to use a conductor of a diameter of two centimeters, equal to 500,000 c.m., or to space the wires more than 10 ft. apart. These figures are based entirely upon the corona loss and not at all upon what might be desirable from the point of view of the amount of energy to be transmitted.

Also very few power plants today can afford to neglect the all day efficiency. This all day efficiency depends very much upon the shape of the load curve. If the load transmitted is subject to wide variations, and has a high peak, it is evident that it is better to suffer a considerable loss for a short time each day rather than put in a large investment to keep this loss down.

These statements regarding efficiency at full load and all day efficiency are of course elementary parts of the well-known Kelvin's law.

It is desirable to call attention, however, to the fact that in the design of these tower lines the cost of the conductor, while it is a large item in money, is not such a very large percentage of the total, and particularly when the cost of right-of-way is included in the total cost of the line.

Of all the parts of the line, however, on which there may



Approximate cost per kw. of transformers for various voltages

be a saving, the only one which can be changed and still keep the design safe is the size of the conductor, and this within comparatively small limits.

It is very difficult to apply Kelvin's law to any transmission project, for two reasons.

1st.—The ultimate cost of the transmission line cannot be determined accurately on account of the largely unknown cost of the right-of-way.

2nd.—The amount of power to be transmitted is in most cases not accurately known.

Thus the tendency is to keep the cost of the conductor within reasonable limits, and permit the size of the conductor to be determined to a large extent by other factors than in Kelvin's law.

The argument has been advanced that the cost per horse-power of a transmission line can be maintained a constant quantity by increasing the amount of power transmitted at the same ratio as the cost of the line. Thus for example if a line cost $100 per horse-power to transmit 10,000 h.p. for 100 miles, this cost could be maintiained for 200 miles by

transmitting three times as much power if the 200 mile transmission line cost three times as much as the 100.

One must admit the force of this argument if there were no limit to the amount of power which could be transmitted. Grounds of policy and safety demand, however, that there be a limit put on the amount of energy transmitted over a single line. The writer has felt that this limit in this neighborhood, and under conditions existing in Canada, is not more than 25,000 kilowatts per tower line.

As further experience is gained in the reliability of operation of steel tower lines, it is possible that this amount may be increased, but there will always be a certain element of risk involved in the transmission of power by overhead means, due to malicious interference or to the necessity of shutting the system down on account of the interference of other constructions which may necessitate such an interruption of service.

Closely connected with the question of efficiency is the regulation. The writer believes that for lines that are designed to transmit large amounts of energy from one point to another, that the permissible regulation is approximately twenty-five per cent.

If a high tension network is designed which distributes energy over a wide range of territory, it is essential that the voltage regulation on this high tension network be made as close as possible, and for that reason a high tension network necessarily costs very much more per horse-power than a line designed to deliver power from one point to another, such as the Shawinigan transmission line. Thus one cannot compare the Shawinigan line with a system such as the Hydro-electric system, and the regulation of the Shawinigan system of about 20 per cent. with the regulation of the Hydro-electric system of about 5 or 6 per cent. These figures include the regulation of the transformers.

Considerable discussion has arisen in the past over the subject of resonance. Some years ago this term covered a multitude of sins and no one had a very clear idea of the phenomena involved. To-day the art has advanced to such a point that what we call true resonant phenomena rarely exist.

Every transmission line has a certain natural frequency, and if electric waves are impressed on the line at the frequency of the line, these waves will traverse the line and be reflected from the ends and there may arise a condition of standing or travelling waves which will develop high potential points and do damage.

The natural frequencies, however, are quite above the ordinary range. For example, in an eighty-seven mile line such as the Shawinigan, the natural frequency is 550 cycles per second.

On some transmission systems the charging of the electrolytic lightning arresters has developed a very high frequency oscillation. This seems to be due to the fact that the lightning arrester is a condenser and the transmission line itself has a very large capacity.

When the lightning arrester is connected to the transmission line through the charging horns, an arc forms which charges and discharges the capacity of the electrolytic arrester at a frequency which depends upon the constants of the line and of the arresters, but this frequency is very high, something of the order of 1,000 cycles per second, and these high frequency waves of small magnitude travel considerable distances over the line, and wherever reactances occur, such as end turns of transformers, series transformers or choke coils of any sort, a high voltage is developed by reason of the passing of the high frequency current through the reactance.

Thus it seems evident that if the electrolytic lightning arresters are to be used for the protection of transmission lines, some method of charging these arresters will have to be developed, which will eliminate the disturbances above referred to.

In designing any transmission line, the voltage of operation must be kept below the critical voltage.

[The author here quotes an approved formula for determining the critical voltage and the power loss].

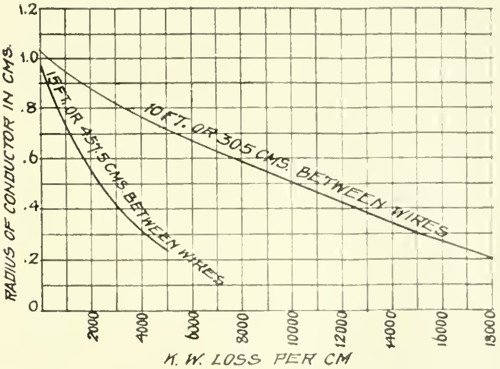
It is not desired to discuss the phenomena of corona loss except as bearing upon the design of a transmission line. It is interesting to note, however, that the corona loss varies considerably with weather conditions, and that snow particularly lowers the critical voltage and makes the line more subject to breakdown.

The critical voltage depends upon the diameter of the wire, and to a lesser degree upon the distance between the wires, so that the corona loss can be reduced by either using larger wires or spacing them at greater distances.

This formation of corona and the resulting loss offer an explanation of a number of operating difficulties which have developed in the past few years.

Considerable trouble has been experienced with all high tension fuse wires, and even fuses on potential transformers on voltages as low as 12,000 volts have given trouble. This seems to be due to the formation of corona on these very fine wires which affects the material composing the wire and ultimately causes the destruction of the fuse.

Before closing the discussion of the electrical design of the line, the writer would mention briefly the status of lightning phenomena and lightning protection as it appears to him at the present time.



Corona losses for 65 mile, 200,000 volt line

Lightning phenomena are considered to be due to current rushes passing from an area of high potential to one of low potential, the discharge being of an oscillatory nature. The frequency of this discharge is of the order of 100,000 cycles per second or greater, and the magnitude of these current rushes may be as great as 10,000 amperes. The duration is exceedingly short, and the wave front exceedingly steep.

The disturbance occurring in the neighborhood of transmission lines induces in the line itself a high frequency oscillation which, travelling throughout the whole or a part of the line, forms points of high potential, or if the wave is of the proper length, the points of high potential may occur at the ends of the line where the transformers act as reflecting points.

(To be continued)

The gross earnings of the Toronto Railway Company for the year ending August 31st, 1913, were $5,880,548, as compared with $5,176,170 a year ago. The city's percentage amounted to $1,007,082, as compared with $863,563 in 1912.

Financial Needs of the Electrical Industry

A Review and Analysis of Future Capital Requirements of the Electrical Industry by Mr. Frank A. Vanderlip, President National City Bank, New York before the Society for Electrical Development

Four hundred million dollars a year, $8,000,000 a week, of fresh capital can profitably be used in the development of the electrical industry in the United States during the next five years. What the calls for new capital might reasonably be expected to reach after five years no one can predict with accuracy, but I believe it is a conservative estimate to say that the intelligent development of the industry as a whole will readily absorb $400,000,000 per annum for the next five years, if that amount is available.

In making such an estimate, one does not need to draw on one's imagination. There is no need to picture broadening fields of application, new methods of production and distribution, nor new uses for energy. A survey of what has been going on about us comes near enough to being a fairy tale. Little more is needed than a grasp of present-day statistics, compared with those of five or ten years ago, to give the basis for such an estimate.

We have seen the cost of construction and equipment of all central stations increase in the five years from 1902 to 1907 from $500,000,000 to well over $1,000,000,000, making an increase of 117 per cent. in that five-year period. We have seen the output in that time go from 2,500,000,000 to nearly 6,000,000,000 kw.hr., making an increase of more than 133 per cent. The five years from 1902 to 1907 is the last period for which we have complete statistics for the whole country. The government is now collecting the figures for the five-year period ending with last year. In doing that schedules have been sent to 7,000 stations and power plants, compared with 4,750 in 1907—and it has been estimated that the cost of construction and equipment of central electrical stations will show an aggregate in 1912 of $2,000,000,000, as against $1,096,000,000 five years ago. Here, then has been a requirement in five years for central station work alone of $900,000,000, or, roundly, $180,000,000 a year, as against a similar requirement in the preceding five-year period of $100,000,000 a year of new capital.

When we think what is certain to be done in the way of electrification of steam railroad terminals and heavy mountain grades, when we reflect on the larger use of electrical energy for industrial power, in agricultural uses, and in the continued growth of necessary interurban lines, we do not need to look further into the possible development of the industry to see a requirement for $400,000,000 a year of new capital.

That means an $8,000,000 new capital issue every week for the next five years. It is such a capital requirement that you gentlemen are facing, and which must be successfully met if your energies are to have an adequate field of display. Can you get it?

Capital Needs in All Fields

It seems to me that there is no more interesting question that can be proposed to those interested in the electrical industry. When the matter is put so concretely as a new $8,000,000 capital issue every week for five years, the size of your financial problem can be readily grasped. To get a full appreciation of the difficulties, you may well glance outside of your own field, however, and note that there will mature within that five-year period well over $1,000,000,000 of steam railroad securities. We may well note, too, that railroad development in the last five years called for from $2,500,000,000 to $3,000,000,000 of new capital, and I would say that there is every reason to expect at least as great demands, in addition to the refunding operations in the next five years. The railroads, then, in five years will need, say, $4,000,000,000 for refunding and fresh capital. States and municipalities, should they take no more new capital in the next five years than they have in the last five, will absorb in the neighborhood of $1,500,000,000 more, so with the $2,000,000,000 your industry will need, there should be provided between now and the end of 1918 between $7,000,000,000 and $8,000,000,000 for these three purposes alone, to say nothing of general industrial and other needs.

These are bewildering figures. They sound more like astronomical mathematics than totals of round, hard-earned dollars. The raising of these sums, however, is the practical problem that financiers have directly before them.

Financiers must count on two elements over which they have no control if they are successfully to accomplish the gigantic task. One factor is the size of the possible investment fund itself—the question whether or not there can be made available a total amount of capital for fresh investment that will meet the demand which can be clearly foreseen in these three directions alone—that of general transportation, the production and application of electrical energy, and municipal capital expenditures.

The second factor is whether or not the outlook in these fields of investment is such that the elements of adequate return and ultimate safety will satisfy the owners of capital and lead them to direct such a vast stream of new investment into these fields.

At this time I will not attempt to go into the first factor—the size of the possible investment fund. That would require a world-wide survey of the growth and wealth and an examination of the effect of modern legislative tendencies; it would need an examination of the drain which the vastly increased rate of taxation here and abroad is putting upon capital; of the terrific wastes of militarism, that cancer which is eating into the financial life of Europe at such an alarming pace, and of the other phases of government expenditure, national, state and municipal, which are absorbing such vast totals of capital into public and largely non-productive uses. It would necessitate taking note of the tendency toward individual extravagance, a tendency that is worldwide and which is cutting into the investment fund to a startling degree.

The Electrical Outlook

Passing entirely this important side of the subject, making no examination as to whether or not the investment fund can possibly be large enough to meet the demands that can be clearly foreseen, let us take up only the narrow question of whether or not the outlook in the filed of electrical industry is such that there is promise of adequate return and ultimate safety sufficient to warrant an expectation that $400,000,000 a year of fresh capital will flow into the electrical public utility field.

In spite of the vast proportions that the electrical industry has already reached, the huge total of capital investment which it represents, the substantial standardization of the business, the complete social and industrial necessity which your work has created and met, electrical securities are still regarded by the general investor, the capitalist, as occupying

a new and only moderately seasoned and tried field for investment.

The Investor in Electrical Securities

Among ten average investors in corporated securities, perhaps not over one, certainly not over two, have as yet invested at all in electrical securities. I think it is conservative to say that among individual investors certainly not over 20 per cent. in numbers have yet recignized that securities issued by electrical corporations have come within a range which will permit investors conservatively to employ their funds in that field. It is not easy for you, perhaps, to realize how very recently it is that the whole field of your business has reached a point where an investor might fairly feel that he was not entering a field of experimentation, that the art was sufficiently advanced and standardized to make it reasonably sure that some brilliant inventor would not upset all financial calculations, that the most up-to-date establishment might not be turned into scrap by advances made in the science long before the investor had made important inroads on the coupon sheet of his bond. As that feeling of insecurity passed and the business became more nearly standardized, there then came to be emphasized difficulties in regard to franchises, until the very phrase "public service corporation" carried with it to the investor's mind unpleasant pictures of difficulties with boards of aldermen, of threatened charters, expiring franchise rights, new forms of taxation, state-fixed rates, and profit divisions with municipalities before undreamed of.

Investors Fear Politics

Four out of five investors at the present time have their minds closed against any investment in securities of electrical corporations, and that is true largely because they fear the effect of present political conditions and tendencies. An investor who has such a fear may not be marching in step to the so-called new freedom; perhaps he does not recognize fully the force of the principles advocated in our new progressive politics. But remember he still controls his own capital; remember that it is his individual decision that determines in what field that capital will be invested. The problem that the banker has to face is to convince investors holding such views that capital issues of this type are attractive, and when you ask bankers to convince enough investors of this so that they will absorb $8,000,000 a week of new capital issues, you are outlining a large task.

The time has now come, in my opinion, when no man with capital to invest in corporate securities, if he has a desire for return that is any larger than government obligations will pay, can longer hold back from the study of public utility investments. The experimental inventive stage is past. The business has a background that has now become broad enough so that one can make valuable comparisons and sound deductions. It has ceased to be a business of only small units, and the tendency is markedly in the direction of great capital issues which shall have at all times a broad market. The dangers from a prejudiced, unwise or unfair vote by a municipality or a board of aldermen are being greatly lessened by the newly organized public service commissions, and these same bodies, recognizing the monopoly character of the business, are guarding it from useless and venal competition, as they are also guarding the investor from too free capital issues by the optimistic developer or the enthusiastic promoter.

We are a long way from having either uniform or satisfactory administration of public service commissions, it is true. This word commission has a sound of wisdom, experience and justice about it, but after all commissions are but composed of men, and sometimes of very poorly equipped even if honestly intentioned men. All this takes us into the question of government itself; but I think no one will deny that the securities of public service corporations are sounder and their future more secure, on the whole, because of the tendency to place the affairs of these corporations under the control of public service commissions.

Meet Proper Public Demands

If I may be permitted to say so, I believe the highest duty that you men who are managing great public service corporations owe to the business in which you are engaged the greatest service which you can perform for the future development of this field, lies in the clear recognition by you of the true public service character of this business and in meeting honestly, intelligently and freely the proper demands that the public makes upon you.

Your dream is of great central stations that will supply energy to vast communities, and from which will radiate trunk lines that will become as necessary in the lives of communities as are lines of transportation, that will produce electricity which will become almost as essential to our every-day life as the blood in our arteries. That dream is fast becoming a reality, and it is right and proper that the public should hold over those who create such a situation a wise and just control. In the degree in which you recognize and meet this right of the public will you get fair treatment in return.

The public is by no means all-wise, when it is not well informed, nor is it always just. You can cite many instances, in your own field, of injustice and of unwise forms and methods of control, but I believe you will find back of every injustice which you have received at the hands of the public some measure of injustice, or unfairness, or lack of sincerity and frankness, on your own part in dealing with the public.

This business you are in requires qualities of statesmanship as well as inventive faculties, technical skill and business acumen. It requires clean-cut recognition on your part that you are creating a condition of affairs wherein the business in which you are engaged becomes of vital necessity in the life of the community, and you cannot and ought not to expect the community to fail to safeguard itself.

The measure in which you recognize the justice of the public's rights, the activity and skill with which you educate the public so that it can make wise decisions, the extent to which you refrain from unfairness or rapacity, and thus give ground for greater unfairness and rapacity in the public's dealings with you, will, to a large extent, be the measure by which capital will come to recognize the security which this form of investment offers.

Hold to High Standards

Those of you who keep in mind most clearly that any deviation from the highest standards on your part in dealing with the public is apt to lead to unfair retaliation and unjust regulation by the public of the business in which you are engaged will find that you are creating about your properties an atmosphere which will encourage the investment of fresh capital. Nor will it be enough for you to be fair and just. You must be both patient and energetic in educating the public, in giving them information which will permit them to form wise conclusions, to make sound laws and to recognize the tremendous importance of both high character and broad intelligence in the men who are appointed to positions on public service commissions.

The field is new. The unavoidable mistakes even at the hands of wise men will be many. In the end those mistakes will react on the development of the community itself, and if the voters can be brought intelligently to recognize this, there will be a strong force of public opinion to compel the appointment of properly qualified men to these positions of far-reaching influence.

Not only must you throw all the force you can in the

direction of securing properly qualified men on the commissions, but you must more broadly inform the public, so that the commissions will have back of them wise laws, framed by men who intelligently comprehend the new and intricate problems which your development of the industry has raised.

Today one of the greatest difficulties that the financial world encounters with public service commissions is on the ground of delay. Sometimes commissions fail to recognize the necessity for prompt action. Frequently they are so burdened and overladen with matters requiring their judgment that it takes months, or even runs into years, before decisions are rendered. Those charged with the duty of financing public service corporations have perhaps more ground for just complaint over commission delays than against the character of decisions after they are made. The commissioners themselves are by no means to blame for these delays. Not infrequently an impossible task is given to them to perform. I believe if the public understood this it would not be difficult to obtain laws which would permit the appointment of extra commissioners, or assistant commissioners, or in some manner to subdivide the work so that public business might be promptly cared for.

If, on the whole, the industry can look forward to fair and intelligent treatment at the hands of voters, municipal authorities and state commissions, it is reasonable from other points of view to anticipate that capital will be found to supply the needs for the development of the next five years, not to look further ahead than that. Nothing in connection with the business is more obvious than that the tendency is toward large units, large corporations and large issues of a single type of security. That all tends directly toward an absolute essential if we are to have a market for public utility securities as broad as the present market for railroad securities. There must be large issues, large enough to warrant the most careful investigation by issuing houses, large enough to make a market that investors can buy and sell in readily, and large enough so that there will be many minds centered on the operating facts back of that security, making the market price of that security represent the combined judgment of many investors, rather than merely the price placed on the security by an issuing house.

The investor wants large issues, but not at the price of over-capitalization. There has been much progress in the last few years in the direction of large issues, which has been brought about through the formation of holding companies that control a number of individual plants. In the creation of these holding companies there has frequently been a tendency toward over-capitalization, toward the building of one corporation on the junior securities of another, and even on the consolidation of holding companies and the creation of another type of security still further away from a primary lien. That tendency should be halted. There is quite enough imagination inherent in the business itself, without letting the imagination of the promoter come into play in creating issues with remote liens.

Principles for Holding Companies

The holding company theory, I believe, is admirable. It scatters the risk; it affords intelligent supervision and engineering; it makes possible cheaper purchasing of supplies; it gives a broader market and a lower cost of capital—but the relation of total capital to total income involves principles that a holding company can no more transgress with impunity than can the original corporation.

If the investor turns from these large considerations, involving the relation of the properties to public opinion and civic control, and the relation of capitalization to reproductive property values and to earnings, and looks at the technical side of the business in the present state of the development of the science, at the outlook for broader uses for more economical production, and at the growing necessity of society for the product which you furnish, then indeed there will be seen ground for the most optimistic view.

As I look back on my boyhood days I think perhaps the keenest hours of pleasure that I can remember were when I was deep in Jules Verne's "Twenty Thousand Leagues Under the Sea" or "The Mysterious Island." I have recently had a pleasure almost akin to that in reading from government reports some statistical abstracts setting forth the course of electrical development, and in studying the report of the committee on progress of the National Electric Light Association. That report of the committee on progress comes as near being a true fairy tale as I know of in current literature. It makes me envious of you men who are engaged in a field that has in it such possibilities—such certainties, one may better say, for the report deals with accomplishments rather than expectations.

Imagination in the Electrical Industry

Diversity factors, off-peak loads, the concentration of central stations, the opening of new fields for the use of energy, and the more complete filling of old ones, makes reading that fires one's imagination. The making of two blades of grass grow where one grew before becomes commonplace by the side of your accomplishments in cheapening the production of electric energy either by water-power conservation or central-station consolidation. When you add to that the economies of diversified load and open up the fields that low-priced current and off-peak loads make possible, you have created a business situation where there is as much need and opportunity for sound imagination as has ever existed in business life—imagination, not mere dreaming, but imagination that means the correlation and new application of known facts. Sound imagination here has unlimited play, and you need it all through your organization and down to every subordinate who comes in any real contact with the problems of labor and the practical affairs of life. As great rivers have affected population or railroad trunk lines have defined development, so will these distributing lines, carrying cheap electricity, affect our future growth.

The nation owes the greatest credit to those among you who have seen this clearly and who are contributing in the largest measure toward a fuller realization of all the possibilities. The man who conceived a 40,000-h.p. generator is as much entitled to honors at the hands of our government as the men who built the steamship Imperator were entitled to be decorated by their government.

The Reduced Cost of Electric Living

You are selling one of the few commodities that have gone down in price, while the cost of nearly everything else that enters into our life has gone up. I note that in seven years in which the cost of living is calculated as having advanced 37 per cent. the average cost of electricity has gone down 17 per cent. You are in the one line of business where the theory of consolidation seems to be fully accepted by everyone who intelligently understands the factors. Elsewhere in business there is a tendency on the part of the public to break up large organizations, but in your field the monopolistic nature of the business is recognized and there is the strongest tendency toward consolidation, and you are demonstrating, in consolidation, the greatest economies.

I note that forty-nine central stations in Illinois have been closed up and that four are doing the work better. I read that 400 central stations in New York State might better give way to forty, or even to ten. I see it demonstrated that what was originally your main business, the furnishing of electric light, is now but incidental, and I am told that the economies of diversified load are so large that the great steam railroads will undoubtedly be able to buy

power from central stations having that diversified load factor more cheaply than they can produce it from their own central stations, however large their requirements may become. The diversity of load-factor which permits the serving of the countless needs of a great community from a central station, and which leads to organization on such a scale that the highest intelligence can be afforded for every detail of supervision and engineering, is the direction in which we are obviously and rightly moving.

An independent municipal lighting plant is either an indictment of the intelligence of the community where it is located, an indication of its failure properly to supervise and control the corporation operating there, or a criticism of the severest character against the management of the private companies. The government might as well undertake the organization of transportation lines solely for service in connection with the post office to carry the mails as for a municipality to undertake economically to produce electricity solely for street lighting.

The interesting statistics of your business show far more rapid increase in gross earnings than is shown by the railroads of the country, great as that increase has been. What is still better, in the face of a rapidly decreasing price at which energy is sold, net earnings show a greater precentage of increase than gross, while the tendency with railroads is distinctly in the opposite direction.

Electricity in Industries

No phase of electrical statistics strike me as being more interesting than the growth of the use of electric power in our industries. In ten years the horse-power of electric motors in use increased from less than 500,000 to nearly 5,000,000, until today about a quarter of the primary power used in the industries of the United States is furnished by electric motors. The most casual study of that development indicates that as yet it is but getting well under way, and that there are as striking advances to be made in the next few years as have been made in the last half dozen.

The statistics of the last five-year period, on the average cost of installations per kilowatt capacity, bear impressive testimony to technical progress, showing as they do marked and steady decline in the cost of installation and the consequent cheapening of product. To a layman it would seem that no field offered more attractive possibilities on the technical side than further improvement in long distance transmission which will still further broaden the field of operation of a central station and tend toward larger units and economical consolidations.

Today a quarter of the total industrial power utilized in the United States is electrical. I am told that competent authorities believe that fully 85 per cent. of the total industrial power can eventually be economically taken over by central electric power stations. This means an addition of more than 10,000,000 h.p. with the present volume of industry and an expenditure in central-station construction of $1,875,000,000 for the production of that amount of electricity.

Those of you who are close to and an intimate part of the astonishing development of the electrical business find these, and a hundred other interesting facts that might be stated, but the commonplaces of your every-day business. They are such sound and substantial facts that you perhaps marvel that four out of every five investors in corporate securities have never bought an obligation of a public utility corporation. You can see how it is possible soon to be furnishing 15,000,000 h.p. instead of 5,000,000 h.p. to the industries of the country. You can see how it is inevitable that great central stations will produce electricity so cheaply that all the energy that is required for wide communities will soon be coming from single central stations.

On the other hand, I can see that, with a little more time for investors to become convinced that a public service corporation is not another name for a target against which to level unfair state and municipal enactments, we may have four out of five investors buying such securities, rather than refraining from doing so.

In the mind of the investor, the outlook for fair public treatment of public-service corporations is the most important single factor in directing investment of capital toward or away from the electrical field.

I firmly believe that this matter of fair public treatment lies largely in your own hands. If you will do so as well with that as you are doing with the technical side of the business, the $400,000,000 a year of fresh capital which you need will be forthcoming.

Winnipeg Developments

Owing to their rapidly increasing load which, at present, amounts to approximately 15,000 h.p., during the peak, the city of Winnipeg Light and Power Department have decided to proceed immediately with the extension of their system. This extension applies to every branch, from the generating station, transmission lines and sub-stations, to their distribution system and arc lighting circuits.

The present equipment at the generating station consists of five turbo-generator units of approximately 30,000 h.p. overload capacity with transformer equipment consisting of six single-phase, 2700 kw. transformers. Tenders have been called for and contracts awarded for additional equipment as follows: The Escher, Wyss Company, of Montreal and Zurich, Switzerland, are supplying three turbines with an ultimate capacity of 6,800 h.p. each, designed to operate at 138.5 r.p.m. with 15 feet of hydraulic head. These turbines are to be direct connected by horizontal shafts to generators supplied by the Canadian Westinghouse Company. The generators will have a normal rating of 5,000 kw. at 6,600 volts and 60 cycles. The necessary transformer capacity is being taken care of by the addition of one 9,000 kw., three-phase, 6,600 to 66,000 volt unit, supplied by the Canadian Westinghouse Company, which firm is also supplying the necessary switching and control apparatus.

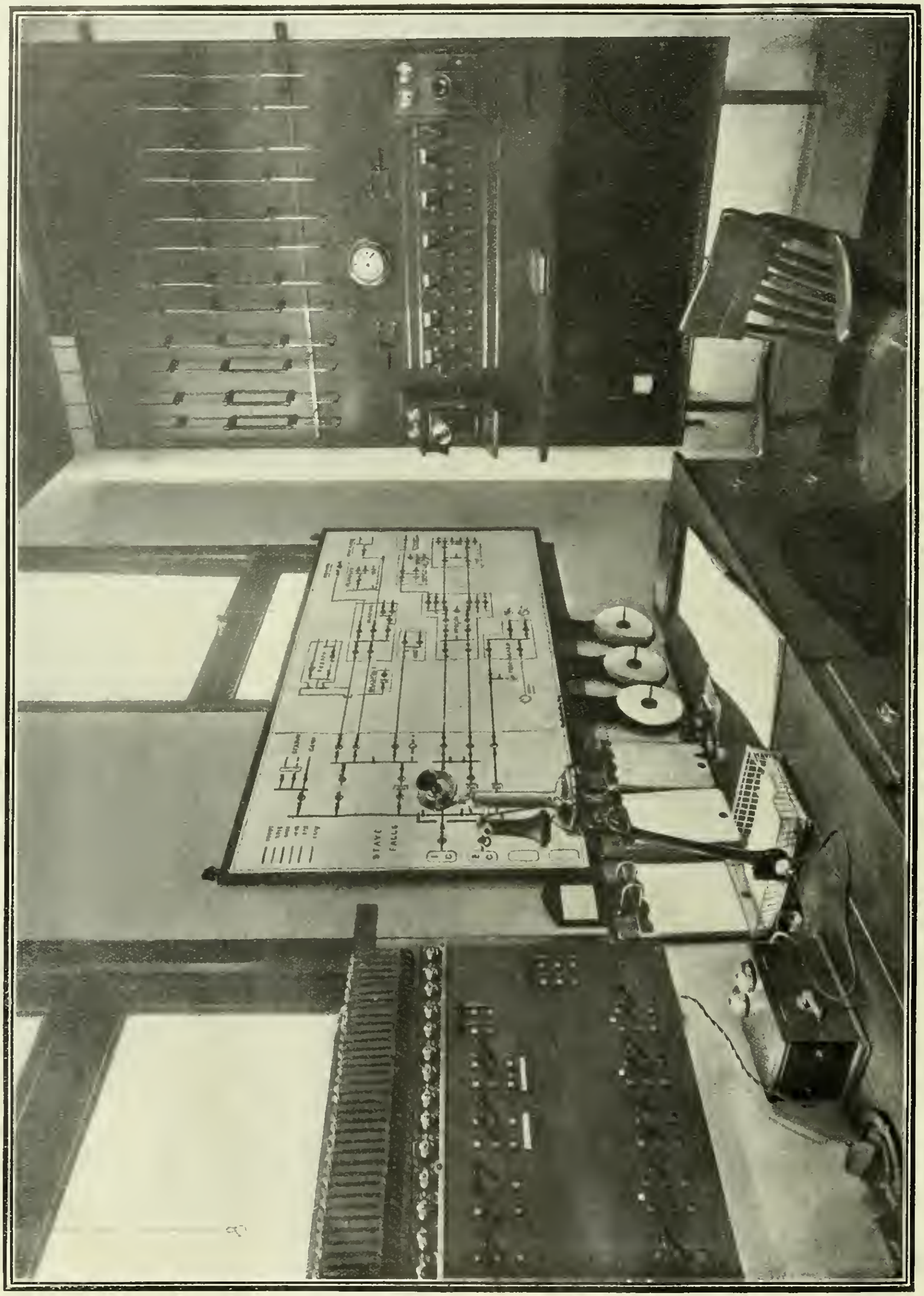
Tenders are now being called for by Mr. Peterson, secretary of the Board of Control, for the erection of a second transmission system on the present right of way of the city of Winnipeg, between Point du Bois and Winnipeg. This line will be designed to operate at 110,000 volts with suspension type insulators.

The extension to the terminal station will double it in size and capacity. The contract for the building construction has been awarded to the Fort Garry Construction Company and the Canadian General Electric Company are supplying new transformer equipment consisting of three 2700-kw. o.i.w.c., single-phase, 66,000 to 12,000 volt transformers.

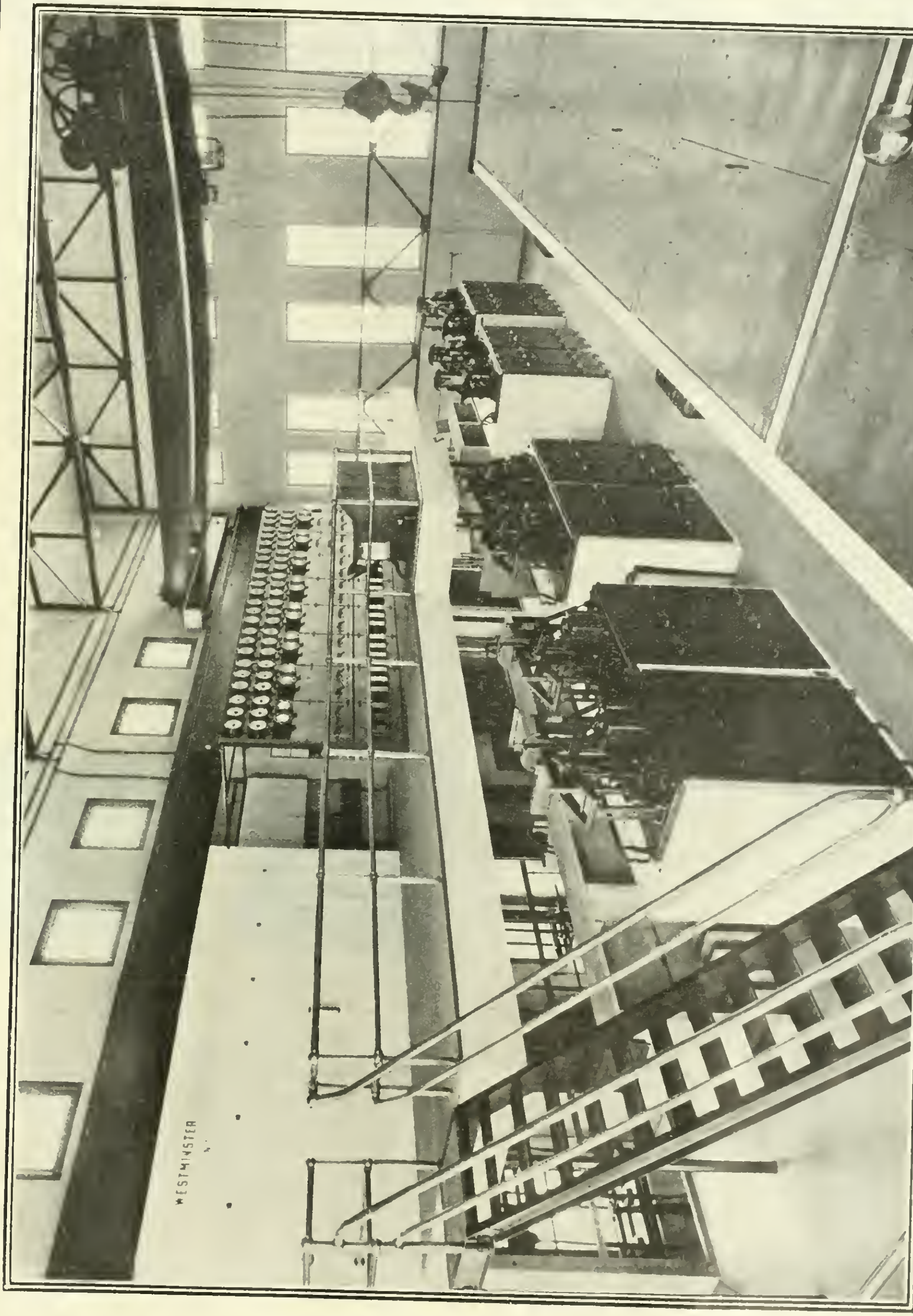
Sub-station No. 2 is being extended to accommodate three 500-kw. single phase, 12,000-2,400 volt transformers which are being supplied by the Canadian Westinghouse Company. This will bring the capacity of this station up to 4,500 kw.

The new equipment at No. 1 sub-station consists of three 500-kw. single-phase, 12,000-2,400 volt transformers supplied by the Canadian Westinghouse Company, and also one 1,000-kw., 600 r.p.m., 550-275 volt motor generator set, the contract for which has not as yet been awarded. This will bring the capacity of this station to 6,000 kw., including 2,000 kw. direct current.

The Imperial Wire & Cable Company, Montreal, received an order recently from the city of Winnipeg for 12,000 feet paper insulated lead covered underground cable.



View of Telephone Room in the Power House of the Western Canada Power Co.—Operating Chart in centre.



Western Canada Power Company. A view of the interior of Ardley receiving station.

Telephone Selector Despatching System

A brief description of the General Railway Signal Company's train despatcher's telephone selector system, which is giving efficient service under exacting conditions, on several heavy circuits

The advantages of motor generator operation, especially in the cases of large, heavy circuits, have been demonstrated in numerous installations throughout the country but this company have further developed this idea by providing an arrangement whereby the turning of a calling key, to send a call, automatically starts the motor generator, which operates and supplies current for the call. When the call is completed the motor circuit is automatically opened and the motor generator stops.

The motor generator is operated from a 12 volt storage battery, which is charged, as required, from local commercial current or from a separate motor generator charging set. The motor generator is mounted on a switchboard from which the various local circuits are controlled. The switchboard not only facilitates the maintenance of the circuit but, by means of the voltmeter and ammeter, gives information as to line conditions. The voltage delivered by the motor generator is regulated by a rheostat and may be increased or decreased as line conditions require.

There are many small selector circuits, requiring low voltage, where the cost of full power equipment would not be justified and dry battery operation for these circuits is recommended. The selector requires a small number of impulses in a call and as each impulse requires less current than the usual selector the aggregate saving is considerable, which prolongs the life of the battery.

Electrically operated selective mechanisms are usually complicated and delicate but the designer of the G. R. S. selector has succeeded in eliminating many of the usual complications without sacrificing any of the essential features. This selector has no time element device and no preliminary or clearing impulses are used in its operation. The company have been very liberal in making allowance for future development in the number of selectors on a circuit as the system provides for a maximum of 324 call stations, or, in other words, each selector may be adjusted to respond to one, two, three, four, five or six of 324 combinations. A circuit having 324 selectors would require a maximum of 36 impulses in a call; circuits having 100, 64, 49, 36 and 25 selectors would require a maximum of 20, 16, 14, 12 and 10 impulses respectively. The selectors are usually equipped with contacts to close two bell or indicator circuits but six or less contacts can be furnished.

Standard time is transmitted to the local stations by means of the selector equipment on several installations and a similar arrangement provides for calling all stations simultaneously. Provision has also been made for the connection of two or more adjoining selector circuits.

When existing contracts have been executed, 9 selector circuits will have been installed, aggregating 922 miles, 283 selectors and 291 bells. Five of these circuits are on the New York Central R. R., three on the Illinois Central R. R., and one on the Toronto, Hamilton and Buffalo R. R. Motor generator operation is used on all these installations with the exception of the T. H. & B circuit, where current is supplied by a battery of dry cells.

The Rochester division of the New York Central, Rochester to Niagara Falls, was one of the first circuits equipped with selector apparatus and was completed in April, 1912. This circuit comprises 76 miles, 36 selectors and 36 bells. During the year ending April, 1913, there was an average of 514 and a maximum of 959 calls per day. The current consumed was 175 kilowatt hours. In this circuit the motor generator is operated from a storage battery, which is on float charge from a 110 volts d.c. commercial circuit. It is stated that this circuit is soon to be enlarged to include another division, at which time the motor generator will be operated direct from the commercial circuit with the storage battery in series with the motor circuit which will materially reduce the current consumption. Standard time is transmitted by the selector equipment on this circuit.

A heavy circuit on the Adirondack division of the New York Central is about to be equipped with this apparatus. This circuit comprises 250 miles, 49 selectors and 56 bells. The line voltage required is 400, which is normally supplied by an a.c., d.c. motor generator, operated from a 3-phase, 110 volt, 60-cycle commercial circuit. The storage battery will be charged by an a.c., d.c. charging set. A d.c., d.c. line motor generator is to be provided as a reserve, in the event of a failure of the commercial circuit, and will be operated from the storage battery.

Another New York Central installation comprises two circuits, one having 78 miles and 32 selectors, the other 108 miles and 40 selectors. These circuits will be operated from the same power equipment. The line voltage required is 200, which will be supplied in the same manner as the Adirondack division circuit, described in the preceding paragraph.

Figure 3 shows the wiring diagram for a typical selector circuit. Each key in the key cabinet starts the motor gen-

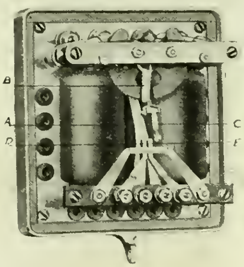


Fig. 2

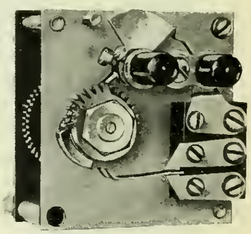


Fig. 1.

erator E by means of the motor control relay C; also each selector is connected to the line, as shown.

To call a station the dispatcher turns the designated key A5 one quarter turn to the right which closes contact 6 completing a circuit from the storage battery B through the motor control relay C which energizes the relay and its armature picks up, closing contact 7; current from the storage battery B now flows through the motor M of the motor generator E. The generator G builds up instantly and delivers such voltage as the line requires, being regulated by the rheostat D.

Returning to the key at A. The key stem of key A5 and the shaft on which the contact discs 2-3-4 revolve are so connected by the gear wheels, pinions and pawls of a simple clock-work mechanism that the movement of key A5 to the right does not revolve the contact discs 2-3-4. When the key A5 has been given a quarter turn and is released, the

mechanism causes it to revolve back to its normal position. As the key A5 begins to return to its normal position the mechanism causes contact discs 2-3-4 to make one complete clockwise revolution as shown by the arrows, and as these discs are fixed on the same shaft it is evident that projections 8-9-10 will reach their respective contact springs 11-12-13 at successive intervals. A make and break results from the engagement of projections 8-9-10 with their respective contact springs 11-12-13 which causes a series of positive and negative impulses that are transmitted to the line L by means of the line relay F as follows: The three teeth of projection 8 engage with contact spring 11 causing three impulses to flow from the storage battery B through coil 14 of line relay F causing a like number of positive impulses to be transmitted from the generator G through contact points F_1 F_2 to the line L and the selectors J_1 J_2. In a similar manner the two teeth of projection 9 engage with contact spring 12 causing the two impulses to flow from the storage battery B through the coil 15 of line relay F, causing a like number

supporting the sectors and is attached to the sector on the left, so that the movement of this sector and the contact arm is uniform.

A positive impulse attracts the right end of the armature which moves arm A and the engaging dog to the left and plunger arm B to the right, this raises the sector on the right, one tooth.

A negative impulse attracts the left end of the armature which moves arm A and the engaging dog to the right and contact arm C to the left. This raises the left sector one tooth.

As the right and left sectors are raised, the plunger arm B and contact arm C move downward at each impulse until both arms are in line with the proper bell contact D or E. These are the preliminary operations mentioned in a preceding paragraph when as stated, the plunger forces contact arm C against the selector contact, closing a circuit from the line to the bell.

The bell rings while projection 10 is in contact with

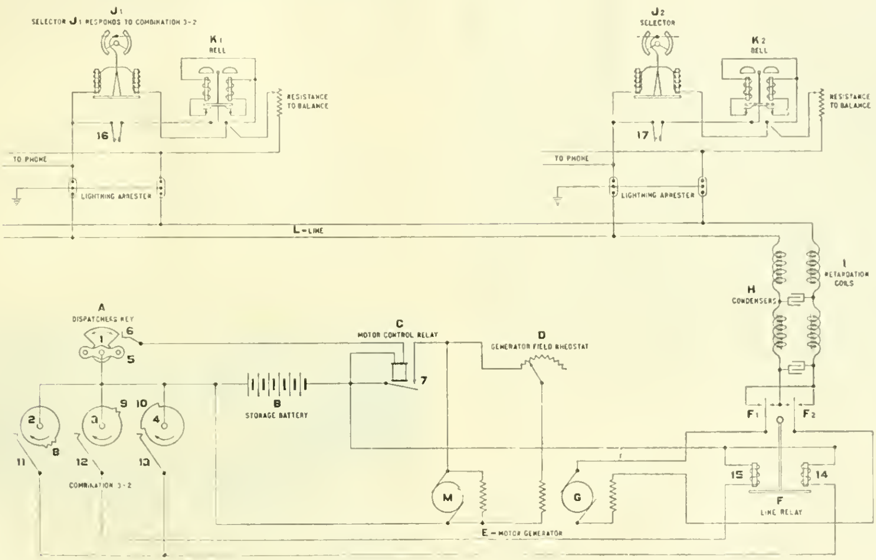


Fig. 3 Typical wiring diagram for selector circuit.

of negative impulses to be transmitted from the generator G through contact points F_1 F_2 to the line L and the selectors J_1 J_2.

This series of impulses, three positive and two negative, being the proper combination to operate selector J_1 will have completed all preliminary movements in this selector, (as will be described in the succeeding paragraph) so that when projection 10 makes contact with contact spring 13, and one long positive impulse is transmitted to the line L and to selector J_1, the depending plunger arm B Fig. 2 of the selector, closes contact 16, this selector being adjusted to combination 3-2 and the bell rings.

Referring to the selector in Fig. 2. The toothed sectors are operated from the armature by means of an arm A and a pawl and rachet mechanism, the engaging dogs of which are pivoted at the top end of the arm A and extend to the right and left, engaging the teeth on the circumference of the sectors. A depending plunger arm B revolves on the shaft supporting the sectors and is attached to the sector on the right, so that the movement of the sector and the arm B is uniform.

Depending contact arm C also revolves on the shaft

spring 13. When this contact breaks, there is no potential in the line L, the pawls holding the toothed sectors in the selectors are released and the several parts are restored to the normal position by gravity. An instant latter contact 6 is broken by the key A5 and its sector 1 returning to the normal position. This de-energizes motor control relay C causing its armature to drop and break contact 7 which opens the circuit between the storage battery and the motor M of motor generator E which comes to a stop.

Condensers H and retardation coils I are placed in the circuit to lessen the noise in the telephone receivers caused by the impulses. With these elements in the line, conversation can be carried on while a call is being sent.

The projections on the contact discs 2 and 3 on each key are arranged so that there is but one such combination on the circuit and as the impulses transmitted to the line depend on the projections on the contact discs 2 and 3, it is evident that each key transmits a distinct series of impulses. Conversely, each selector is adjusted to respond to its proper key. If a selector was provided with six working contacts to operate six bells, it would be necessary to provide six keys in the key cabinet to operate this selector.

Electric Railways

Gas-electric Car Operating on Vancouver Island

The Victoria and Sydney Railway, a short line operating on Vancouver Island has now been using a self-propelled gas-electric car with satisfactory results for some weeks. The car is making 110 miles per day, and on two days of each week handles a 30-ton trailer. The car is 4 ft. 8½ in. gauge, weighs 51 tons, and is equipped with two motors, each of 100 h.p. capacity. The total length is 70 feet 7⅜ inches; the length of the passenger compartment is 9 feet 11 inches, and the baggage compartment 10 feet 11⅞ inches; the length of the cab is 11 feet 11 inches; total between bolster centres is 51 feet 6 inches; the wheel base is 6 feet 10 inches and the diameter of the wheel is 33 inches; total wheel base of the car is 57 ft. 11 inches. The body is built almost entirely of steel. The gas engines consist of a two-cylinder, 4-cycle gasoline engine with two integral air pumps directly connected with the lighting generator and an 8-cylinder, 4-cycle main engine supplied with low tension magneto and air starters. The main generator is of the multi-polar commutating pole type, direct connected to the main gasoline engine. The auxiliary lighting generator is of the multi-polar compound wound type and is direct connected to the auxiliary engine. The motor equipment consists of two G.E. 600 volt, series, commutating pole railway motors mounted directly on the axle of the forward truck, with nose suspension.

Track Construction in Ottawa

The Ottawa Electric Railway Company operate 55 miles of track in the city of Ottawa and suburbs. Within the city limits the track is practically all 7 in. Tee, Lorain section, 80-335. Under the company's franchise the city lays and maintains all street pavements, the company paying an in-

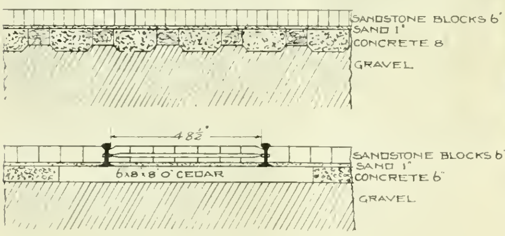


Fig. 1—Track construction, Ottawa.

creased mileage rental for paved streets occupied by its tracks. Most of the paving in the city is asphalt, with 6 in. sandstone block on the track allowance. The city paving specification calls for 6 inches of 1-3-6 concrete between ties, which must be increased to 8 inches directly under the rails. The construction is shown in Fig. 1 6 in. x 6 in. x 8 ft. cedar ties, spaced 2 ft. centres, tie bars 6 ft. centres and continuous joints are used in this construction. Where the company has laid tracks in streets already paved, the construction has been as shown in Fig. 2, the ties being laid on 6 inches of concrete.

Toronto's New Municipal Cars

The city of Toronto recently placed in operation, on their St. Clair avenue line, half a dozen cars, of the most modern description, manufactured by the Niles Car Company. This number will be increased to twenty in the near future, half of which will operate on the St. Clair line and half on the Danforth avenue line, which is not yet quite ready for operation.

The new cars are illustrated herewith. They are double truck, double end operation, pre-payment type; the track

Interior Toronto municipal cars, St. Clair Ave.

gauge is 4 ft. 10⅞ inches; the trucks are the Baldwin type with wheel base 6 ft. 3 inches. The motors are C. G. E. number 80, 45 h.p. each, 550 volts, direct current. Four motors are installed on each car, the motor being hung inside the wheel base. The cars are geared for a speed of 30 miles. The wheel diameter is 33 inches, the tread 2½ inches.

The length of the car body from the end plates is 31 ft.

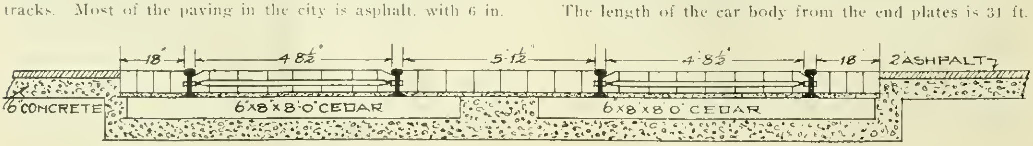


Fig. 2—Track construction on paved streets, Ottawa.

City of Toronto's new municipal cars operating on St. Clair Ave.—One of twenty

t in.; the front and rear platform is 6 ft. 6 ins., the length over buffers is 45 ft. 1 in.; the width over sills is 8 ft. 7 ins.; the extreme height from track to top of the trolley base is 12 feet.

The seating capacity is for 48 persons; the main passenger compartment is furnished with 16 cross seats, reversible backs, and four corner seats; the isle is 22 inches wide; the seats are upholstered in standard gray canvas lined rattan. The reversible back seats have bronze corner grab handles, steel pedestals and ends, but no foot rests.

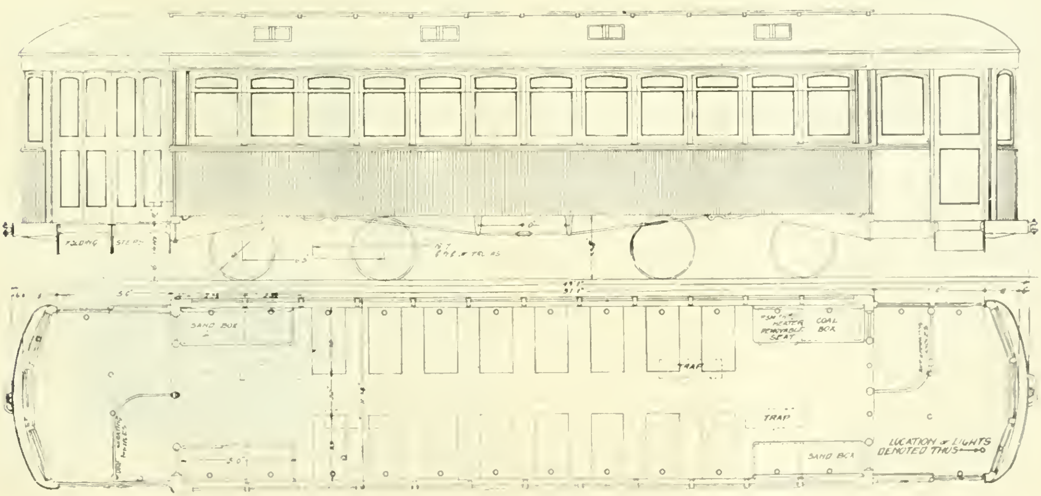
The vestibule floor is depressed below the car floor approximately 11 inches. The roof is of the single arch type extending the full length of the car, with single arch type hood. Eight automatic ventilators—4 on each side—are fitted in the roof.

The cars are equipped for double-end operation, each vestibule being fitted with three doors so that which ever way the car is moving there is one door for exit at the front and one door for entrance and one for exit at the rear. These doors are controlled by levers conveniently placed for the motorman and conductor. The single door at the front is of the sliding type; the rear door fold back well out of the way of the passengers entering or alighting.

The car is lighted with tungsten lamps placed as shown in the plan herewith. Crouse-Hinds type of head lights are installed. A feature of the illumination is the method of lighting the steps. This is accomplished by placing a single lamp just above the step level and under the car so that the full light from one lamp shines on each step when it is lowered. When the steps close up automatically with the doors these lamps are not visible.

Each car is supplied with two trolley catchers of the Knutson No. 2 retriever type. Both hand and air brakes are installed, an air compressing equipment being installed on each car. Each car is also supplied with four Hunter ornamental destination signs, placed one over each vestibule side window and one on each side of the car, near the centre. Sixteen sanitary hand straps are installed in each car opposite the longitudinal seats only. Fenders are of the Watson type.

The Peter-Smith system of hot air ventilation is installed. The cars are painted a dark green color and the letters on the side read "City of Toronto" with the city crest shown prominently in the centre.



Plan of Toronto's new cars—A most modern equipment in every way.

Illumination

Elementary Principles of Illumination

I—Reflection of Light

Light, if unobstructed, travels in a straight line, a single point of light sending out rays in all directions—east, west, north, south, upward and downward to exactly the same extent. Very much of this light is, plainly, lost unless we can devise some means of turning back the rays toward the earth.

When any obstruction is placed in the path of a ray of light, one of three things happens. (1) The ray may be reflected or turned back from the obstruction. (2) The ray may be refracted or simply turned slightly out of its course, or (3) the ray may be absorbed, i.e., destroyed altogether.

Which one of the above conditions is obtained depends entirely on the physical properties of the obstruction placed in the path of the ray, and very much on its surface condition. It follows that one of the important aims of the manufacturer of reflectors is to produce a surface that will pre-

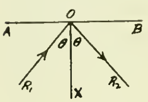


Fig. 1.

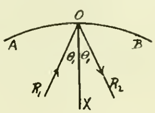


Fig. 2.

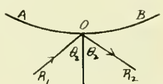


Fig. 3

vent the penetration of light rays. The surface must, in general, be hard, highly polished and permanent. The latter factor is especially important, as a surface which deteriorates is apt to become absorptive and, so, a large percentage of the light rays are destroyed.

The law governing the reflection of light is definite but simple. If a ray of light R, meets a reflective surface AB, Fig. 1, it passes out from that surface as R_2 making the angle R_1OX equal to the angle R_2OX where OX is at right angles to AB. The angle R_1OX is called the angle of incidence and the angle R_2OX is called the angle of reflection. Therefore, the law governing reflection of light can be stated simply as follows—the angle of incidence is equal to the angle of reflection. This law is equally true where the reflecting surface is not a plane. For example, in Fig. 2 AB represents the arc of a circle and OX can be drawn so that it is still at right angles to AB at the point O. In this case, just as in the previous one, the ray R_1 passes back as R_2 so that the angle of incidence R_1OX is equal to the angle of reflection R_2OX. Again, AB may have the shape of Fig. 3 with the reflective surface on the convex side; if OX is drawn at right angles to this curve at the point O the ray going in as R_1 will be sent back as R_2 so that the angle of incidence still equals the angle of reflection.

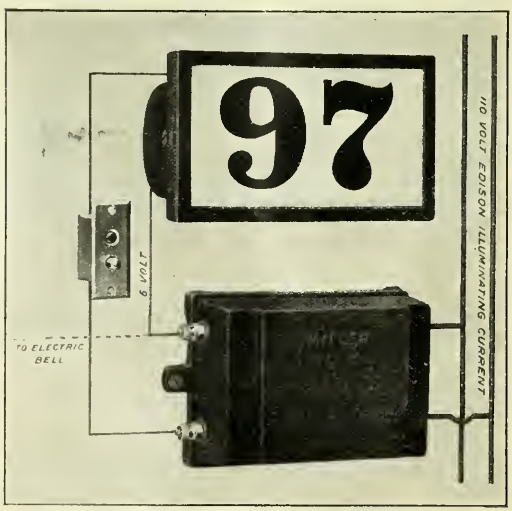
It cannot be emphasized too strongly that this is a law to which there is no exception. The law is not even approximate; it is absolutely exact and unchanging under all conditions of reflection.

It is this law of reflection chiefly that makes the science of illumination possible. By its control we are enabled to turn back the rays that would otherwise pass outwards and upwards and reflect them in such direction that the illumination can be made uniform all over a given area. The very exactness of the law, however, makes care in its control most necessary, and best results are only obtained where the reflectors are constructed with an accuracy comparable with that of the law. It can be easily seen that a single flaw in a reflector will materially alter the distribution of light over the area served. A consideration of these points will lead the purchaser of glassware to appreciate the necessity of installing equipment as accurately and uniformly made as it is possible to obtain.

It will further be seen that the matter of control becomes very much more complicated where the source of light is not a single point. Take, for example, the filament of an incandescent lamp where the source of light may be considered as coming from an almost innumerable number of points. These are all sending out rays, in all directions, which are reflected according to the fixed law given above. The fact, however, that no two lamp filaments are quite the same shape, and that possibly no single lamp is the same on two successive days, indicates how big the propositions are that the manufacturers of reflectors and illuminating engineers have to grapple with.

Illuminated House Number

The Miller illuminated house number illustrated herewith is a new form of illuminated number made by the Dongan Electric Manufacturing Company, 745-747 Franklin



6-volt transformer operating bells, house number, etc,

street, Detroit, Mich. The light is obtained from a 6 volt, 2 candle-power lamp operating in connection with a low voltage transformer. The transformer is attached to the alternating current lighting circuit. In addition to being used for the lamp, the transformer will also operate bells, buzzers, door openers, and annunciators. The power consumption is trifling, the entire wattage being only from three to four watts when the lamp is lighted. The apparatus is furnished complete with number, lamp, transformer and switch.

New Lighting Units

A new type of indirect luminous bowl lighting unit, as shown herewith, has just been placed on the market, by the National X-Ray Reflector Company, of Chicago. In their earlier designs, the luminous feature has been secured by

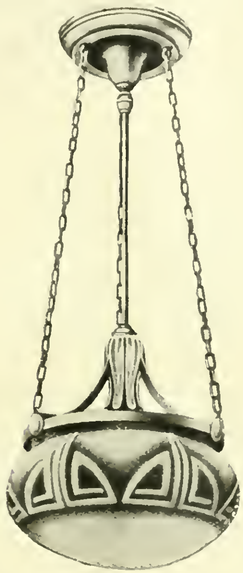


Fig. 1.

using translucent glass-ware in the bowl of the fixture, and illuminating it from within by a small lamp, specially supplied for this purpose. In the new unit the small lamp is dispensed with, and the illumination of the bowl is supplied by

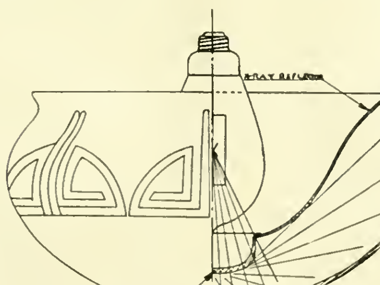


Fig. 2.

light which is permitted to escape through on opal diffuser, placed at the base of the conical reflector, as shown in the line drawing herewith. In no case is it desired to illuminate the bowl to a higher intensity than that of the ceiling, as the only object in illuminating it at all is to make it more pleasing in appearance. Not more than ten per cent. of the total light flux generated is required to secure this intensity and each fixture is designed with this condition in mind.

The possibilities of this arrangement in fitting into decorative schemes is practically unlimited. Color effects may be obtained by means of colored glass-ware, or by coloring the separate lamp, where that is used. The bowl may be hand painted or decorated in any of the ways known to artisans in this ware. Beautiful combinations may also be built up by using opaque fixtures with art glass panels or by means of leaded bowls of colored glass. Figure 2 shows the equipment of Figure 1 in a bowl designed for bedrooms, but which, if given a brownish tint is most suitable for den or study use.

The final solution of modern lighting problems is two

Fig. 3.

fold—to supply adequate and proper illumination and to please the senses from a decorative point of view. Both these conditions appear to be adequately fulfilled by the above designs.

A handsome installation of portable lamps is also shown in Fig. 3. This is the new type recently described in the Electrical News, and is designed for the double purpose of supplying an art lamp using indirect lighting and to provide illumination, where desired without wall or ceiling fixtures. Fig. 3 is a view of the tea-room in Hyde Park Hotel, Chicago. In this type of unit the large lamp which supplies the general illumination is enclosed in a standard eye-comfort opaque glass reflector, which directs practically all the light to the ceiling. Below these reflectors small lamps are arranged, frosted or colored if desired, used for the illumination of the silk shade and the surface immediately below the lamp. These lamps are separately controlled so that either may be used alone when desired.

It will be seen from the photograph that the results of using this type of lamp are very effective. Objectionable and harsh shadows are removed and details of the room are well brought out. There is also a note of distinction and comfort rarely found in this class of artificially lighted rooms.

A contract has been awarded to Dawson & Company, Limited, Winnipeg, for ninety ornamental street lighting poles at $110.60 per pole. This contract had previously been awarded the United States Steel Products Company but has been cancelled as they could not undertake to ship in the time specified.

The Dealer and Contractor

Wiring Existing Buildings

By Mr. C. E. Robertson

The problem of wiring old buildings has two very distinct phases; one the wiring of residences, and the other, the wiring of small stores and business houses. The problem assumes different proportions, depending upon the age of the city served by the central station.

To arouse public interest in the electric equipment of homes, considerable thought should be given to proper publicity.

The advertising booklets of the large manufacturers of lamps and heating devices are stirring up considerable public interest, and some of the larger lighting companies are putting out through their publicity departments quite a varied assortment of descriptive literature, explaining how easily and economically old houses may be electrically equipped. Some of this descriptive matter is undoubtedly excellent; on the other hand, a number of the circulars and booklets are very poor and will serve to defeat the efforts that are being made to standardize good practice in electric wiring.

For example, the following is an extract from one of the booklets issued by a large eastern company:

"The fixture of the dining room too, may be utilized for light cooking. Here with a combination electric grill, small steaks may be broiled, eggs fried or boiled and bread toasted. Delicious coffee can be cooked on the electric percolator, and so on—this booklet is far too small to adequately describe the many other labor and time saving cooking devices that an electric light service brings to your dining table."

The purpose of a lighting fixture should not be corrupted in the minds of the public by any such extravagant promises as the above, nor is it good practice to attach heating devices on the efficient dining room fixture that is suitable for the use of Mazda lamps. A serving table, with baseboard outlets of ample capacity back of it is the only reasonable piece of dining room equipment on which light cooking operations should be attempted. The poorer class of customers, who could not afford this arrangement, would, in all probability, have a combined kitchen and dining room, and no kitchen should today be without one or more baseboard receptacles.

Proper publicity of a wiring campaign is so essential to its success, and its continued success, that we should be extremely careful not to hold out false promises to prospective customers; and especially is this true when we consider that the average electrical contractor, whom we are all trying to educate and co-operate with, looks to the practice of the lighting company as an example of what to do.

Publicity in a store-wiring campaign is a much simpler proposition, in that the average small merchant understands the value of effective illumination in the display of his wares, and also the advertising value of an electric sign and well lighted windows in attracting the attention of the people passing his shop.

A lamp socket is designed to care for the base of an incandescent lamp, and it is short-sighted policy to encourage the use of heating or motor driven appliances from lighting fixtures, especially when the lighting circuits are laid off usually with number fourteen wire and twelve sockets in the circuit. The matter of drawing up specifications for heating appliance wiring should be given the earnest consideration of the manufacturers, lighting companies and contractors. In Baltimore it has been the practice since the beginning of the residence wiring campaign to give free with each old house wiring job, a separate heating circuit of number twelve wire with a twenty ampere outlet in the kitchen, and making only a nominal charge for additional outlets, which may be accepted by the customer upon recommendation of the salesman.

The distribution of lighting outlets and the arrangement of switch control have been sufficiently well standardized to pass over with a brief comment on the influence of the Mazda lamp on lighting fixture design, and (because of its being rated in watts) its effect in simplifying wiring layouts for a sufficient and well distributed amount of illumination.

The Selling End

The selling end of the wiring of existing buildings is the most interesting part of the subject to the sales manager, and the question can be sub-divided as follows:

Shall the lighting company do the selling?

Shall it be left in the hands of the contractors?

Should a co-operative arrangement be made whereby both contractors and lighting companies are in position to sell wiring on standard specifications which would substantially standardize the selling price?

All three ways have been, or are being tried and the results obtained will be interesting matters for discussion. To the lighting company in a large city, with only a small percentage of existing buildings wired and using service, the temptation is very strong to get out after the business, and obtain a large volume of this class of wiring as quickly as possible, if it can be done on a self-supporting basis. The activity of the lighting company along these lines naturally creates a demand, and a greater demand, than would be created if the matter were left entirely in the hands of the contractors, and the latter naturally benefit in the securing of orders from prospects created by the efforts of the lighting company. Some of the contractors, of course, will strenuously object to the encroachment on their field by the lighting company, but if the efforts of the company are restricted to the securing of wiring orders from prospects whose houses have never been wired, the more intelligent contractor with an established business does not complain, but looks upon it more as a stimulus to the business generally. It is usually true that people who are skeptical as to the safety of equipping their houses electrically, will have more confidence in the work of a large responsible corporation than in that of a small irresponsible contractor.

If the lighting company leaves the problem entirely in the hands of the contractor, it is bound to be handled in a slip-shod manner, unless an incentive is given to the contractor by subsidizing him, as the Cleveland company does,

Paper read before the Sales Managers' Convention at Association Island.

and unless the lighting company, through the medium of the contractor, can offer to the public easy terms of payment covering a period of twelve months or more. This is true because the larger contractors, who have a substantial credit, are looking to new work in large buildings in which class there is not the element of speculation that exists in small old houses both in the matter of profit and of receiving the money for the job when it is completed. Failure to collect accounts receivable when due has been the cause of the failure of a considerable number of electrical contractors. The average small householder, in making improvements to his home, requires easy terms of payment, and there are comparatively few electrical contractors, as yet whose businesses are well enough established to permit them to offer deferred payment terms; then, too, if such terms were offered, it is essential that competing contractors for this class of work should add to their selling prices a sufficient percentage to cover the interest on the money tied up. Wide variance in the estimates submitted by several contractors on the wiring of an existing building, proves conclusively, that the element of chance is appreciated by only a few. On one job in Baltimore, on which half a dozen contractors submitted bids, the prices varied from $200 to $800. A prospective customer receiving such bids is bound to be at a loss in awarding the contract, and generally asks the lighting company for advice. This sort of bidding hurts the wiring business generally, as it estabishes a doubt in the mind of the prospect as to the character of work that is permitted. Some of the older contractors hesitate to bid in competition on this class of work, and will take the business only on a time and material basis. The smaller contractors have not the capital invested to enable them to successfully advertise, nor to successfully solicit the business in sufficient volume to satisfy the lighting company.

Co-operate With Central Station

If, on the other hand, the central station company has an established wiring department, and has managed it on a self-supporting basis with satisfactory results as to the volume of business obtained, it is not difficult to make an arrangement with those contractors who find the wiring of old houses profitable, which will enable them to offer their prospects the same deferred payment terms as offered by the lighting company. As an incentive to these contractors, the lighting company may agree to pay them for each complete old house installation, the order for which with service application, to be turned in to the office of the lighting company, an amount depending upon the average cost to the company of securing the same class of business through its own sales organization.

The price at which wiring orders can be taken in a given city by both the lighting company and a group of responsible contractors must be worked out on a fair average basis for each class of wiring undertaken. This is quite an undertaking and necessitates the employment of a man who is capable of estimating the cost accurately, and who has sufficient experience in the wiring business to know how much it costs a contractor to conduct his business. The best method of arriving at proper selling prices for wiring is to obtain from accurate cost records the average unit cost for labor and material for each class of wiring. The question of what unit to adopt is still an open one. In the majority of cases, the first conclusion is to adopt the outlet as the unit, but the cost of wiring a lighting outlet depends upon the number of lights to be burned at that outlet, and for a switch outlet upon whether the switch is a single pole, double pole, three-way or four-way, and how many lighting outlets are to be controlled by it. Similar conditions apply to baseboard outlets and floor outlets. In the writer's judgment the proper segregation would be to use a unit price for ceiling, bracket and baseboard lighting outlets, a unit price for switch outlets and a unit price for appliance outlets. If each of these unit prices is arrived at from average costs and the addition of a gross profit on the cost of 33 1/3 per cent., they will prove satisfactory in the majority of cases to both the contractor and the lighting company. With the use of the Mazda lamps, the cost of wiring a lighting outlet depends upon the total number of watts to be consumed at that outlet, or the average number of outlets in a group constituting a full circuit of 660 watts.

In considering this question in Baltimore, we went to the very foundation of the cost element and established an average price per watt wired for, using a unit price for single-pole switches, a unit price for pairs of three-way switches, and a unit price for a group of two three way, and one four-way switches. By adding 33 1/3 per cent. to the average cost, we expected to make an average gross profit of 25 per cent. on the selling prices.

The influence of the circuit cost on the outlet cost is a refinement of the problem that necessitates very complete detailed data, in order to make fair prices to two neighbors occupying the same size and the same style of house, one requiring more wattage because of his willingness to make a greater investment in the fixtures and shades—having greater light absorption properties—than the other, therefore requiring more circuits for the same number of outlets.

The cost of the service wiring from the meter loop through to the center of distribution should be absorbed in the first circuit. This will make the average cost per lighting outlet, for the minimum number of lights, greater than for the outlets over and above the first circuit.

In Baltimore, where it has been the practice to give a heater circuit free, we have also pro rated the cost of this circuit over the outlets in the first lighting circuit.

The circular dial attached hereto has been arranged for the convenience of the wiring salesmen and the prices shown are based on the average costs as obtained from 175 jobs completed by the company. It will be noted that these prices cover installations up to and including 35 outlets on 6 circuits. For larger jobs the price per watt, as given in the salesmen's hand books are used. The prices for switch outlet wiring and other fittings are given on the back of the dial.

Two-storey seven-room houses built in rows are typical in Baltimore. The following estimate is given for wiring for 11 outlets with 21 lights, including a free heater outlet in the kitchen and service entrance as required by the rules of the company:—

Price for outlet wiring (from dial)	$43.25
Price for one single pole rotary	3.00
Price for seven single pole flush switches	24.50
Price for 2 sets of three-ways	15.00
Total Billing Price	$85.75
Cost of job:—	
Material	$38.60
Labor	25.00
Car Fare	.60
Auto Expenses	.15
Total Cost	$64.65
Gross Profit	21.10

Contractors generally figure on 20 per cent. profit and base their approximate estimates on $3.50 per outlet for ceiling outlets, and $4.50 per outlet for wall outlets.

For the above sample house, the approximate price which a contractor would give would be as follows:—

11 Outlets at $3.50	$38.50
1 Spr Switch	3.00
7 Spf Switches	28.00
2 Sets 3-Ways	11.00
Total	$80.50

The price quoted would range from \$60.00 to \$90.00, depending on the amount of competition.

We are now co-operating with the contractors by turning over to them, daily, a list of prospects that are secured by our street appliance canvassers. To those contractors who have signed a bonded agreement with us we offer to finance house wiring jobs, paying the full amount of their bill, less 6 per cent. in 30 days after completion of the work and we billing the customer direct in a twelve-monthly-payment basis. Those contractors turning in a complete house wiring order with service application we pay \$5.00 to, provided the customer had not received an estimate from our wiring salesmen within 60 days prior to the taking of his order. This plan seems to be working out very nicely and is resulting in a better feeling on the part of the contractors, generally, toward the company.

New Combination Flush Receptacle

A new combination flush receptacle is being manufactured by the Arrow Electric Company of Hartford, Conn. The receptacle may be used interchangeably with plugs for standard receptacles on the market, and has the added advantage of being adapted for use with a "Polarity Plug." A grove in the receptacle permits the insertion of the polarity plug in one position only, while it does not interfere with the insertion of the standard plug. The receptacle is rated at 12 amperes, 250 volts. This polarity feature is of great advantage where fixed polarity of current is necessary, as in the use of electrically driven machines and storage batteries.


Receptacle


Standard Plug.

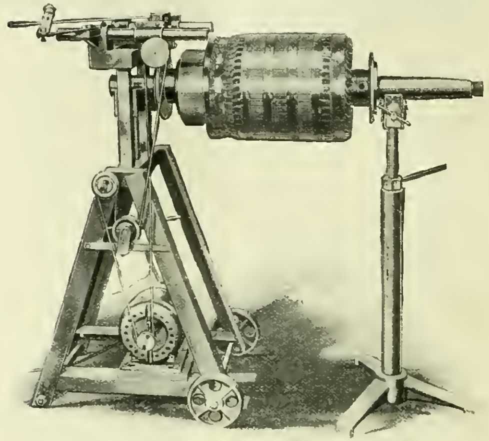

Polarity Plug.

New P. & S. Devices

Pass & Seymour, Incorporated, are just placing on the market a new devise, illustrated herewith, namely, keyless, pull and key receptacles respectively. The base of these receptacles is covered with brass, making a very neat and graceful appearance. These are additions to the Fluto interchangeable receptacles manufactured by this company.

Portable Slotting Machine

A new portable commutator slotting machine is being sold by the Electric Service Supplies Company to meet the demand for a portable machine that is properly built and capable of the highest class of rapid and accurate work. The illustration shows this machine complete with an armature mounted in position. It is adjustable for armatures of varying lengths and diameters, and is capable of handling from the smallest air compressor commutator to those of 18-inch diameter and of any practical length. This machine is easily handled and carried from place to place, so that it is frequently more advantageous to take the machine to the armature, than vice versa. The commutator end of the armature shaft is supported in a V-bearing, which is adjustable in height to suit the diameter of the commutator so as to bring the cutting saw to the proper depth. This saw is clamped by a nut to the spindle, which runs in a long bearing bolted to the sliding head. The bearing is removable and is cheaply replaced when worn. The sliding head is carried by two shafts projecting over the commutator, and is moved over the slots by the lever, as shown in the illustration. The pivot positions of the operating lever can be changed and adjusted to suit the size of the commutator. The lever is placed at a convenient height for the average operator to accomplish the quickest and best results. The other end of the armature shaft is supported by a special stand which may be adjusted in height according to the diameter of the commutator and to bring it level with the cutter. An extremely valuable feature is embodied in the stand in that it is adjustable crosswise so as to bring the travel of the saw always in line with the mica slots. This adjustment is of great importance because the mica frequently does not run true with the shaft. This portable commutator requires a $\frac{1}{8}$ horsepower motor to operate but may be used as a stationary tool by dispensing with this and belting direct to the counter or line shaft. The weight of the machine proper without the motor is 148 pounds. The weight of the rear support is 35 pounds.

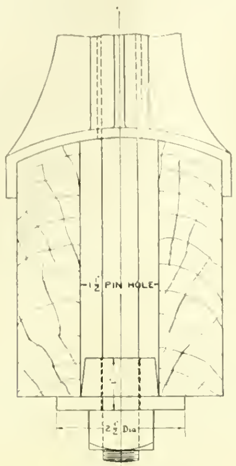

Portable commutator slotting machine.

The Ontario Railway and Municipal Board have been experiencing a good deal of trouble in obtaining the necessary returns from the different independent telephone companies throughout Ontario. The secretary of the board has now sent out a circular to the delinquent telephone companies advising them that unless their returns are made promptly the board will impose the penalty clause in the telephone act which provides for a fine of \$25 for this offence.

Copies of the 1913 edition of the National Electric Code are being distributed by the Canadian Fire Underwriters' Association, Montreal. The new edition embodies alterations recommended by the National Fire Protection Association, and copies may be obtained by applying to Mr. Tate, the chief electrical inspector of the Underwriters' Association,

Adapter Cross Arm Washer

A washer or bushing of special design has been placed on the market by the Electric Service Supplies Company for use in connection with their Keystone truss pins. The function this washer performs can readily be seen in the accompanying illustration. When used in conjunction with these Keystone truss pins they readily adapt the cross arm hole of 1½ inches diameter so that an iron truss pin having a curved



Special design bushing.

base, as shown, may be used. This adapter makes possible replacing wooden truss pins with iron pins without placing new cross-arms. The benefits to be derived can be appreciated when difficulties such as running a heavy feeder over an old line or the necessity of having pins of greater strength at curves are considered. In either case it has been found unnecessary to change the cross-arms or bore new holes. This method of installation is also practical for complete renewals of line truss pins.

Canadian General Electric Takes Over the Stratford Mill Building Company

Some time since the Canadian General Electric Company acquired by agreement with the Allis-Chalmers Company of the United States the right to manufacture and sell exclusively in Canada their various lines of manufacture. The Canadian General Electric Company at their various works have sufficient equipment for manufacturing most of the apparatus for which these rights were acquired, such as hydraulic machinery, sawmill machinery, mining machinery, etc., but had no equipment for the manufacture of flour mill machinery, grain elevator equipment, etc., such as manufactured by the Allis-Chalmers Company. In order to be fully equipped to take care of all business offering in this line, the Canadian General Electric Company have just acquired by purchase all the plant and assets of the Stratford Mill Building Company, at which plant in future will be manufactured not only the well-known lines of the flour mill machinery heretofore manufactured by the Stratford Mill Building Company, but also the wider range of machinery and equipment as produced by the Allis-Chalmers Company. Mr. William Preston, who has been the president of the Stratford Mill Building Company, will continue actively identified with the flour mill machinery business as manager of the flour mill machinery department of the Canadian Allis-Chalmers Company.

The Burnham Engineering Company

A recent change in Canadian engineering circles is brought to the attention of the readers of the Electrical News by an announcement on another page of this issue, viz. the severing of his connection with the firm of Messrs. Kilmer, Pullen & Burnham, by Mr. George C. Burnham, and the formation of The Burnham Engineering Company, Limited, with Mr. Burnham as president, and Mr. L. J. Belnap of the Rudel-Belnap Machinery Company, of Montreal, as vice-president. This new company has been fortunate in securing the agency of the Amalgamated Electric Company of Sweden, whose reputation as builders of high grade electrical machines has for years been well established throughout Europe, their plant at Ludvike, Sweden, being of a most efficient design and layout. Their products comprise a complete line of electrical generators, motors and transformers, switchboards, switching equipments, etc., and also electric heating appliances. The Amalgamated Electric Co. are also the first to put on the market an electric iron ore smelter. Messrs. Burnham and Belnap have been connected for some years with engineering schemes throughout Canada, and their past record is a sufficient guarantee of the success of the new enterprise.

A New Sign Idea

The Dennison sign shown in the illustration is unusual in that it is illuminated by Cooper-Hewitt lamps instead of by the ordinary incandescents, which are so generally used. In addition to being very brightly illuminated this sign has a distinctive color—the light emerald green characteristic of this lamp. The letters are made of wood, painted white and mounted on a frame work of galvanized iron pipe. The capital letters are 10 feet high and the small letters 5 feet. The illumination is accomplished by eight lamps, each enclosed in a galvanized iron box with glass door, the lamps

Sign Illuminated by Mercury Lamps.

being equipped with a specially designed reflector which directs the light so as to cover the entire surface of the letters. The sign is 80 feet long and the total wattage is 1380, only about half the amount, it is claimed, that would be required to properly illuminate this sign with incandescent bulbs.

The Half-Watt Lamp

The 34th convention of the Association of the Edison Illuminating Company was held in Coopertown, N.Y., September 8 to 12, the registration list reaching a total of 360. An interesting exhibit was that of the new "one-half watt" tungsten lamp. This new lamp is filled with nitrogen gas and ranges in size from 500 to 5,000 candle power. The smaller units are naturally less efficient, specific consumption being about .75 watts per candle power, but in the 5,000 candle power size, an efficiency of .5 watts per candle has been obtained. One of the speakers at the convention also told of results which he had obtained with a neon lamp. One of these lamps was exhibited and gave out an orange red light with the specific consumption of about .5 watts per candle.

The municipality of St. Remi, P.Q., has just installed a small system of electric lighting, power being supplied by a local firm.

City Will Supply Assiniboia

The hearing of the application of the city of Winnipeg to supply light and power to the municipality of Assiniboia, took place on August 29th before Judge Robson, public utilities commissioner. A decision granting the application was handed down. This decision simply confirms one of the charter rights of the city of Winnipeg, but as the city and the municipality could not agree on the establishing of poles, etc., through the latter, the matter was referred to the public utilities commissioner. At the hearing the city was represented by Theo. A. Hunt, K.C., City Solicitor, and the municipality of Assiniboia by E. L. Taylor, K. C. Reeve Bannatyne of the municipality was also present.

The question of the right of the city of Winnipeg to sell electric energy in St. Boniface for light, heat and power purposes came up before Commissioner Robson of the Manitoba Public Utilities Commission, September 2nd. The formal application of Assistant City Solicitor Prudhomme was heard and the commissioner adjourned the hearing until Monday next. The evidence will then be taken and the defence put in. The proposition of the city of Winnipeg is being objected to by the city of St. Boniface and the Winnipeg Electric Railway Company.

W. E. R. Co. Acquiring More Power Facilities

According to a published interview with Sir William McKenzie on his return from abroad, it is understood that what are known as the Reese interests have been taken over by the Winnipeg Electric Railway Company. The business of the latter company has increased to such a point that the peak load is much higher than the water plant capacity and for this reason the Reese properties were taken in.

Trade Publications

Adjustable Speed Motors—Bulletin number A4130—issued by the Canadian General Electric Company on adjustable speed direct current motors.

Annual Report.—The Ontario Railway and Municipal Board have just issued their 7th annual report covering the year ending December 31st, 1912.

The Textile Quarterly—Number 4—issued by the Westinghouse Electric and Manufacturing Company, on the subject of motor drive in the silk industry.

Electricity on the New York Central—A booklet issued by the Canadian General Electric Company, describing the electrical equipment on the New York Central system.

The Lighting of the Home.—A booklet published by the National X-Ray Reflector Company, being a re-print from the Fine Arts Journal, on the subject of correct illumination in the home.

Curtis Steam Turbines—Booklet Number A4137, issued by the Canadian General Electric Company, describing and illustrating their Curtis steam turbines in capacities ranging from 100 to 2,500 kilowatts.

Wiring Specialties—Catalogue number 16—on the wiring specialties manufactured by the Arrow Electric Company, of Hartford, Conn. This is a catalogue of ninety-six pages completely illustrated.

Electric Hoisting Plants—Catalogue 3002A, issued by the industrial and power department of the Westinghouse Electric and Manufacturing Company, on the selection of motor equipment for electrically operated hoists.

Gear Cases—The Electric Service Supplies Company are mailing a series of five booklets covering the details embodied in the manufacture of their Keystone Steel Gear Cases. These booklets describe the gear case under the several heads—Steel, Tightness, Brackets, Fit, and Weight.

Voltage Regulators—Bulletin No. A4129, issued by the supply department of the Canadian General Electric Company, descriptive of small feeders and voltage regulators. The bulletin deals at some length with the proper layout of distribution systems and explains the theory and mechanism of this type of regulator.

Parian Ware—Catalogue No. 35, issued by Gill Bros. Company, of Steubenville, Ohio, describes, with illustrations, a number of their direct, semi-indirect and indirect lighting fixtures. The Canadian General Electric Company are Canadian agents for this product.

Linotype Machines.—Descriptive Leaflet No. 3698, issued by the Westinghouse Electric & Manufacturing Company, covers motors for driving Intertype and Linotype machines. The characteristics necessary for this service are explained and application views shown of motors driving these machines.

Magnetic Switches.—Descriptive Leaflet No. 3351, issued by the Westinghouse Electric & Manufacturing Company, describes alternating-current magnetic switches known as the Type F. These switches are designed to withstand the severest forms of industrial service. They are fully described and illustrated in this leaflet.

Arc Lamps—Bulletin No. A4035, issued by the supply department of the Canadian General Electric Company, descriptive of series luminous arc lamps. The catalogue is well illustrated and explains in detail the mechanism of the lamps, and the illumination curves of the various types, and gives descriptive information regarding a number of actual installations.

Metal Reflectors.—Bulletin No. 30, just issued by the Holophane Company, describes the Holophane-D'Olier metal reflectors for lighting of mills and factories. This bulletin describes at some length the value of correct illumination and illustrates diagramatically a number of scientific principles, outlining correct practise in the selection and installation of proper reflectors.

The Textile Quarterly—issued by the Westinghouse Electric & Manufacturing Company, is, as its name indicates, a publication issued every three months devoted to the use of electricity in the textile industry. The cover is a unique reproduction of a piece of linen. This particular issue is devoted to motor drive in the silk industry, and a number of interesting motor applications are shown.

"Selecting Motor Equipment—for Electrically Operated Hoists," is the title of a Bulletin (Section 3113) just issued by the Industrial Power Department of the Westinghouse Electric & Mfg. Company. This pamphlet gives a quantity of good interesting data and information on the subject of hoisting equipment. A number of formulae applying to this work are given, together with a number of examples. A diagram of connections of different systems are given, and the bulletin has a question sheet for securing data on installations of this kind.

The Toronto Electric Light Company have recently purchased 2200 h.p. of Riley Self-Dumping Underfeed Stokers. These stokers are to be used in a stand-by steam station as a reliability reserve for the power from Niagara Falls. These boilers will carry banked fires week in and week out and must always be ready to pick up the load instantly in case of any transmission line trouble. The reciprocating movement of the grates which slice the fire of the Riley stoker is so well adapted to quick steaming that a boiler at the Narragansett Electric Light Company recently showed 300 per cent. of rating in 6 minutes from a fire that was banked for twenty-four hours.

Current News and Notes

Aurora, Ont.

Tenders have been called for the supply of motor driven pumps and auxiliary equipment.

Brampton, Ont.

The town council recently passed a by law authorizing the expenditure of $15,000 for the extension of their electric system.

Brantford, Ont.

The following tenders in connection with the Brantford street lighting system have been accepted: 152 ornamental cast-iron standards, to be supplied by the Ornamental Lighting Pole Company; 152 magnetite lamps including cut outs and regulators, the Canadian General Electric Company; two 750 kv.a. transformers, Canadian Crocker Wheeler Company; recording instruments, Canadian Westinghouse Company, high and low tension switch and control equipment for sub station, Canadian General Electric Company. A pulmotor is also being purchased.

The city has won its case against the Brantford street railway system and has been awarded tax arrears of some $27,000. The franchise is also to be annulled unless certain necessary extensions and improvements are carried out within twelve months.

Calgary, Alta.

Superintendent McCauley's annual statement for the year ending June 30th, 1913, shows net earnings of $64,492.

The proposition to extend the street railway system to Shaganappi Park is meeting with favor. Certain property owners in this vicinity promise to pay the entire cost of the extension and guarantee operating costs for the first four years.

The City of Calgary have recently placed an order with the Imperial Wire & Cable Company, Limited, Montreal, for lead covered paper insulated underground cable. Approximately 40,000 feet will be installed by the city, under the supervision of Mr. R. A. Brown, city electrical engineer.

Charlottetown, P. E. I.

The city recently passed a resolution offering to buy out the plant of the Charlottetown Light & Power Company, and operate it as a municipal enterprise. The franchise of the company has still eight years to run. The capacity of this plant is 500 k.w., a.c., consisting of two units, one steam and one gas driven. Generation is at 133 cycles, single and two phase, 1,100 volts. The suggested price is $96,000.

Dundas, Ont.

The town has taken over the street lighting system and will make a number of improvements and additions. The equipment will include wire, brackets and lamps.

Edmonton, Alta.

September 15 was the day set for the inauguration of a service on the Edmonton Interurban Railway Company's system between Edmonton and St. Albert. A self-propelled car is being used.

Esquimalt, B.C.

The B. C. E. R. Co. have completed the installation of an electric lighting system in this municipality and 75 lamps are in operation.

Fergus, Ont.

It is planned by the Hydro-electric Power Commission of Ontario to supply Fergus and Elora with 400 h.p., the line being run out from Guelph. It is calculated that the rate to these towns would be $33.67 per h.p. per year, the price at Guelph being $22. A by-law to the amount of approximately $10,000 will likely be submitted in each town.

Fort William, Ont.

The corporation of the city of Fort William offers a special rate for cooking purposes at 1½ cents per kilowatt hour. This rate is subject to the minimum charge of $1 a month plus 25 cents meter rental. The rate for domestic and commercial lighting in Fort William is 5 cents per kilowatt hour with 10 per cent. discount. Power is sold to motor users at 4 cents with 10 per cent. off, or on a flat rate of $25 per h.p. per year, net.

Galt, Ont.

It is announced that the light and power consumers in Galt are now increasing at the rate of one a day, there having been 252 additions this year up to the middle of September. Two years ago there were 455 costumers as compared with 1,350 at the present time.

Lacombe, Alta.

A contract has been awarded to the Canadian Westinghouse Company for a number of 6.6 ampere series arc lamps; also a number of tungstens to be placed in series, with necessary hoods, regulator, regulator panel and instruments.

Lethbridge, Alta.

An agreement has been signed between the Lethbridge municipal railway system and its employees. The following wage schedule was accepted:—1st six months—25 cents per hour; 2nd six months, 28 cents per hour; 2nd year—30 cents per hour; 3rd year—32 cents per hour. On public holidays the men are paid time and a-half, and on Sunday on the basis of 9 hours pay for 7½ hours work.

Medicine Hat, Alta.

In addition to the unit which is at present being installed, the power committee of the town council are considering the wisdom of placing an order for another generator.

The city of Medicine Hat is at present installing a high tension sub-station for transforming the current to 2,000 volts. The building is a reinforced concrete construction with hollow tile faced with brick curtains. The contract for the construction work has been awarded to Sackrider & Turner for $10,000. The electrical equipment is being supplied by the Canadian General Electric Company. The station is expected to be ready for operation on November 30th.

Montague, P. E. I.

The Montague Electric Company of Montague, P. E. I., are building a reinforced concrete flume and dam, which will necessitate the removal of about 2,000 yards of rock and earth and the construction of a quantity of heavy masonry. No electrical equipment will be required at the present time.

Montreal, Que.

The Bell Telephone Company have awarded the contract for a new telephone exchange in St. Urbain.

The city of Montreal contemplate the purchase of a number of standards for the police and fire department.

The following is the tentative programme for the winter session of the Montreal Electrical Society, arranged by Mr. P. T. Davies, chairman of the papers committee: Mr. G. M.

Gest, "The Conduit Situation in Montreal"; Mr. B. T. MacCormick, of Canadian Allis Chalmers, "Induction Motors"; Mr. L. E. Hamilton, Northern Electric and Manufacturing Company, "Fire Alarm Systems"; Mr. A. E. Reoch, Marconi Wireless Telegraph Company of Canada, "The Marconi System"; Mr. Cole, Canadian Allis Chalmers, "Transformers."

Plans are being submitted and tenders will likely be called shortly for 225 single standards with lamps.

The Montreal Water and Power Company are building a second transformer house, 20 x 40, at their plant in Point St. Charles. The company are supplied with power by the Montreal, Light, Heat and Power Company at 2,200 volts, the same company also supplying the transformers—three of 1,000 k.w. each. It is proposed to build a duplicate line and also to duplicate the transformers and other equipment, the water company constructing the transformer house. The duplicated plant is intended for use in case of emergency.

Alderman J. Robinson, of Montreal, was re-elected president of the Dorchester Electric Company, at the annual meeting held in Quebec. Hon. N. Garneau, Quebec, is the vice-president, and Mr. W. T. Wilson, managing director. The directors are: Messrs. Gustav Proteau, Quebec; L. A. Cannon, K.C., Quebec; Jos. Gosselin, Quebec; G. E. Tanguay, Quebec; C. P. Beaubien, K.C., Montreal, and F. Gold Lyman, Montreal.

Although the annual statement of the Quebec Railway, Light, Heat and Power Company shows an increase in gross receipts of $108,375, the total being $1,524,200, there is a rise in operating expenses of $160,255, making a decrease of $51,880 in the net earnings. Miscellaneous income is higher by $42,297, but on the other hand fixed charges increased by $131,737, the surplus of $73,801 showing a falling off of $141,320. The surplus of $72,801 for the year added to the amount brought forward on June 30th, 1912, brings the total surplus up to $147,341. The sum of $27,641 was received from the Dominion Government on account of subsidies and was applied to the cancellation of $30,000 bonds according to the trust agreement. At the annual meeting it was stated that $91,500 had been expended on maintenance during the year and that the various properties and plants of the road and its subsidiaries had been maintained at a high state of efficiency. A revision of the by-laws was authorized by the meeting reducing the number of directors to six, the new board now consisting of Sir Rodolphe Forget, M.P., president; Hon. Robert Mackay, and Messrs. J. N. Greenshilds, K.C., Lorne C. Webster, Paul Galibert and D. O. Lasperance, M.P. The retired directors are Hon. J. P. B. Casgrain, Messrs. L. C. Marcoux and O. B. d'Aoust.

Mr. William He, Canadian manager of the George H. Shuman Electric Company, Montreal, is about to pay a visit to the principal European countries, with a view of purchasing a number of Christmas novelties.

A contract has been awarded the Imperial Wire & Cable Company, Limited, Montreal, by the Toronto Hydro-Electric System, for approximately 22,000 feet of 2 and 3 conductor paper insulated lead covered underground cable, conductors ranging from No. 6 B & S to 500,000 C.M.

The Canadian British Insulated Company, Limited, Montreal, have taken out patents for paper insulated lead covered cables. The patented device consists of a spiral wrapping of aluminium tape over which is one lap of paper. As is well known, great difficulties have been experienced in detecting the presence of moisture due to a defect in the lead in extra high tension cables, and in some cases months have elapsed before moisture has disclosed itself by causing a blow-out. In order to obviate this difficulty and enable the engineer to feel the pulse of his cable the company have introduced this open sheathing, by the use of which the presence of moisture is immediately detected by measuring the insulation resistance between the lead and the metallic tape.

About fifty members of the Montreal Electrical Society on September 20th visited the Angus Shops of the C. P. R. They were received by Mr. Moody, the superintendent, and Mr. J. A. Shaw, the electrical engineer. The visitors were divided into parties, and were shown around the immense works by several gentlemen who acted as guides. The entire shops are motor driven, a steam plant being installed, and in addition current is supplied by the Montreal Light, Heat and Power Company. One of the chief points of interest was the power-house, where are also situated the Ingersoll Rand compressors. The C. P. R. have a special department for manufacturing and repairing batteries and automatic dynamos for lighting their cars; while there is also a shop for electrical welding.

Neepawa, Man.

On September 17th a by-law was passed authorizing the expenditure of $18,000 for the extension of the electric light system.

Ottawa, Ont.

The city of Ottawa have placed an order with the Imperial Wire & Cable Company, Limited, Montreal, for the supply and installation of 47,000 feet 3 conductor No. 2/0 B & S paper insulated lead covered cable, and 1,100 feet 3 conductor No. 2/0 B & S steel taped cable, both insulated for 3,300 volts.

Owen Sound, Ont.

It is expected that the council will shortly close a contract with the Hydro-electric Power Commission of Ontario for the development of Eugenia Falls on Beaver river. It is now calculated that this Falls can supply 1,400 h.p. without storage and 4,000 h.p. with storage facilities. The requirements of Owen Sound at the present time, however, would not exceed 800 h.p. for which a $31 rate has been quoted by the commission.

Prince Albert, Sask.

A by-law was recently passed authorizing the expenditure of $275,000 on the erection of an auxiliary steam plant. Mr. Raymond Wright is superintendent of the light and power department and the work will be carried out under his supervision.

Regina, Sask.

Tenders are called till October 25th for one 3,000 kw. steam turbine with condenser and one 25-ton hand-power crane.

Souris, Man.

Tenders have been received for the supply of equipment necessary to establish an electric light and power plant at Souris, Man. Two direct-current 50 k.w. generators are required; a storage battery and switchboard; also equipment for street lighting, including a certain amount of underground work.

Swift Current, Sask.

Tenders have been called for the construction of a new power house.

St. Catharines, Ont.

Conferences have been held between representatives of the C. P. R. and the city council regarding the construction of an electric railway connecting Hamilton and St. Catharines. It is understood a preliminary contract has been drafted to be submitted to the electors if approved by the C. P. R. officials.

The Hydro-electric Power Commission estimate the cost of the step-down sub-station and distributing system, with all

the necessary equipment, at approximately $90,000. A by-law will be submitted in the near future.

St. John, N.B.

It has been decided to instal a system of telephone despatching between St. John and Moncton, N.B., on the Intercolonial Railway, and tenders have been invited for the necessary equipment. The automatic block system will be introduced at the same time.

Thorold, Ont.

The Beaver Board Company of Thorold are installing two 1,200 h.p. 250 r.p.m., 2,200 volt motors for operating grinders. The contract for these motors, as also for the switchboard, has been awarded to the Canadian General Electric Company.

Toronto, Ont.

Weiss & Biheller (Canada) Limited, importers of electric shades, indirect lighting fixtures, etc., have vacated their offices on the second floor at 21 Richmond St. W., Toronto, for more commodious and recently remodeled show-rooms on the ground floor at 19-21 Richmond St. W.

Truro, N.S.

At the beginning of the present year a representative council was elected who have carefully studied the situation and have decided to install a street and public building municipal lighting plant. Though their conclusion was reached only three or four weeks ago a large number of poles have already been erected and negotiations are in progress for all other requirements.

The electrical equipment needed consists of one 50 kw., a.c. generator; switchboard and accessories, including meters, switches, circuit breakers, etc.; distributing transformers; insulated wire, insulators, cross-arms, etc.; 400 or more street lighting fixtures, including 36 -in. goose necks, with reflectors, brackets, etc.

Vancouver, B.C.

The new directory just issued by the British Columbia Telephone Company contains 27,355 names. This includes the lower mainland, Agassiz to Ladner, but does not include Chilliwack or Mission City or the rural line to Lulu Island or the Delta which are owned by separate companies. In Chilliwack there are 600 subscribers and in Mission 135 so that the total number of telephones on the lower main line is over 28,000. Of this number 23,506 are in Vancouver.

A new agreement has been reached between the B. C. E. R. Co. and their employees, fixing the scale of wages for the next two years.

Windsor, Ont.

It is said that some negotiations have taken place between the mayors of Windsor and Detroit in reference to the supply of Niagara power for municipal purposes in Detroit.

Woodstock, Ont.

The Hydro-electric Power Commission of Ontario will give a demonstration on threshing and corn-cutting by electricity on a number of farms in this vicinity.

Manitoba Branch C. S. C. E.

A meeting of the Membership Committee of the Electrical Section of the Manitoba Branch of the Canadian Society of Civil Engineers took place on September 5th. Although the last winter session was a most successful one and was enthusiastically attended, it is planned to set a new record this winter, both in point of attendance and papers read. An active campaign for new members will be waged this fall.

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Recent Developments in Illumination

Recent developments in illumination have taken place simultaneously along two supplementary lines—greater efficiency in the lighting units themselves and better control of the light these units give out; and remarkable as the advances have been in the former case it would appear that quite as valuable, if less spectacular, progress has been made in the latter. Original cost, operating cost and quantity of light are still important factors in the minds of all light customers, but there is a noticeable increase in the number of employers who place quality before quantity and who recognize that "more work and better work," by their employees, means much more in dividends than keeping down either the initial or operating expenses. The demand for better lighting has necessarily been met by improvements in the design of installation, by a better distribution of the units, a recognition that certain types of light sources have special applications, and, last, by very marked improvements and variety in the manufactured glass-ware. The field of each of the three types of indoor lighting—direct, semi-indirect, and indirect—is becoming more clearly defined and no attempt is now made by the advocates of either one to belittle the value of the others. Direct illumination, where only the lower part of the room needs to be lighted, will continue to be the most attractive both as to cost and maintenance, but developments in the art of glass making have raised the efficiency of the semi direct and the indirect units to such a degree that the greater cost of installing and operating these is not of sufficient importance to offset the many advantages that have been experienced by the use of one or other of these systems in a great variety of installations. In street lighting the tendency is to get away from the clusters, especially on main thoroughfares where a very high illumination is desired. The magnetite and luminous arcs are growing in popularity and the most recent development, the half watt incandescent lamp, will doubtless find a field where a quantity of illumination above the average is required. For residential streets the series low voltage tungstens appear to be gaining in popularity and different successful methods have been devised for the proper regulation of the current supply for these. The neon lamp is a very interesting development of which the commercial value has scarcely yet been demonstrated.

Neon Lamps

Considerable progress has been made in the manufacture of lamps using some inactive gas, such as carbon dioxide or nitrogen within the tube, and more recently the gas neon has been utilized for the same purpose. Neon is a constituent of the atmosphere to the extent of about one part in 66,000 and on account of the difficulties met in its preparation has been looked on as one of the vary rare gases. It has a weight of approximately two-thirds that of air and is exceedingly inactive in that it does not combine with metal or other gases.

Recent experiments by Monsieur G. Claude, in France, on the liquefaction of air have resulted in the production of neon in considerable quantities as a by-product. M. Claude states that with a modest apparatus for liquefying air he has been able to secure 100 litres of neon in one day. Looking around for a use for this gas he has hit upon the idea of utilizing it in tube lamps and in a recent lecture given before the Illuminating Engineering Society, during the recent convention in Pittsburgh, demonstrated the high illuminating efficiency of the neon tube. Tubes were shown of an approximate length of 10 ft. and diameter 2 inches, which gave out very intense light with an efficiency claimed to be approximately one-half watt per candle power. The disadvantage of this light for ordinary illumination is that it is lacking in blue rays and is very rich in red. M. Claude pointed out, however, that since the Cooper-Hewitt lamp has a similar deficiency in red rays these two sources of light, the mercury lamp and the neon lamp, might be made supplementary to one another. This was also demonstrated, a combination of two mercury tubes and three neon tubes of approximately the same size giving an illumination which brought out very accurately the colors in a variegated bouquet shown by the speaker. The commercial value of the neon lamp is not very plainly shown as yet but for certain kinds of illumination, such as sign lighting, where the spectacular effect is desirable, the neon lamp should find a broad field. The life of the lamp is claimed, in its recent development, to be entirely satisfactory.

The Half-watt Lamp

Improvements in the tungsten lamp have constantly been along the line of greater efficiency and longer life. In a general way any improvements in efficiency tended to reduce the useful life of the lamp, as for example, an increase in voltage, which not only shortened the life of the film, but produced blackening of the bulb in a much shorter time. Investigations have been carried on almost continuously to discover the cause of the blackening which was thought at first to be due to certain chemical changes taking place as a result of a trace of water vapor being left in the lamp bulb. Later work by the engineers of the General Electric Company has shown to their satisfaction that the cause of the blackening of the ordinary well-made tungsten lamp, as well as those run at higher than their rated efficiency, is simple evaporation of the filament.

To overcome this evaporation two general methods have been tried with considerable success, (1) introduction of

gases such as nitrogen or mercury vapor, at atmospheric pressures, into the lamp bulb, and (2) the changing of the location of the deposit by means of convection currents in the gases so that the bulb opposite the filament does not darken. The present result is the production of a high candle power nitrogen filled lamp of very high efficiency. In the largest units, from about 1,500 c.p. up to about 7,000 c.p. the efficiency is between .4 and .5 watts per candle with a life of 1,000 hours or more. This takes a current of at least 20 to 30 amperes and operates best on alternating current. In very large units it has been considered best to run the lamp off a small transformer giving a voltage depending on the size of the units, but large lamps running on standard lighting 110 volt circuits have shown an efficiency better than .5 watts per candle power.

The temperature of the filaments is several hundred degrees higher than those of the ordinary tungsten lamp which causes the light to be very much whiter and in reality a near approach to daylight. By the use of special colored screens it is possible to obtain a bright daylight color with an efficiency of about 2 watts per candle.

Lower Rates in Vancouver District

From the beginning of October it has been decided by the management of the B. C. Electric Company to bring the lighting rates in the districts adjoining the city to the same level as those which obtain in Vancouver. To bring the rates in line with those charged inside the city limits represents a decrease of from approximately 27 per cent. to 50 per cent., according to the quantity of current consumed. It has also been decided to effect a reduction in the charge for the rental of meters outside the present limits of the city from 20 to 15 cents per month.

These altered figures will affect thousands of householders, as they cover the municipalities of Point Grey, Burnaby, Richmond, Delta, Surrey, Langley, Matsqui, Sumas, Chilliwack, Coquitlam, Port Moody and other points on the lower mainland of the province served by the company. The following table indicates the reductions which have just gone into force:

	Former Rate	Rate Oct. 1
First 50 kw. hours	$0.15	$0.11
Next 50 kw. hours	.14	.10
Next 300 kw. hours	.13	.09
Next 300 kw. hours	.12	.08
Next 300 kw. hours	.11	.07
Next 500 kw. hours	.10	.06
Next 500 kw. hours	.09	.05
Over 2,000 kw. hours	.08	.04
Meter rental	.20	.15

There is a rebate of 20 per cent. for the prompt payment of lighting rates; the charge for meter rental is net.

Winnipeg Street Lighting

Since inaugurating the city of Winnipeg power plant the street lighting system has increased very rapidly. There are now over 2,000 arc lamps in service, as compared with 220 in the year 1900 and 700 in the year 1905.

These 2,000 lamps are made up as follows:

Alternating enclosed lamps suspended from wooden poles	1077
Magnetite lamps suspended from wooden poles	427
Magnetite lamps erected on ornamental poles	688

The alternating enclosed lamp is confined to the outlying districts, while the magnetite lamp which is a 6.6 ampere luminous arc lamp, is confined to the business district and the central section of the city.

At the present time the city of Winnipeg has some $400,000 invested in street lighting equipment which shows that the capital expenditure per lamp up to date is in the neighborhood of $200. This amount, of course, includes station equipment, real estate and all other accessories belonging to the street lighting department.

In connection with Winnipeg's claim to being one of the best lighted cities in America it is interesting to note the following figures:

City	Population	No. Arc Lamps	Lamps per 1,000 of Population
Boston (proper)	800,000	5,000	6.25
Montreal	500,000	3,200	6.40
Los Angeles	375,000	3,700	9.86
Portland	207,000	2,978	14.38
Vancouver	175,000	1,695	9.66
Hamilton	100,000	846	8.46
Winnipeg	200,000	2,000	10.00

The city is now contemplating the purchase of some carbon flame equipments for use in the outskirts. This is a 10 amp. alternating series lamp and is supposed to possess distinct advantage over the luminous arc in the matter of power factor, all round efficiency, and in the saving of current consumption. The only noticeable difference to the layman between this carbon flame lamp and the luminous arc is that the carbon flame has a slightly yellow tinge which, though noticeable, is not objectionable.

The results in the operation of the street lighting department for the past year in Winnipeg show that the total annual charge for the alternating series lamp is $48, while the luminous arc approximates $63. These figures include interest, depreciation, sinking fund, maintenance and operation.

Vancouver Convention A. I. E. E.

The Annual Pacific Coast Convention of the American Institute of Electrical Engineers held this year in Vancouver on September 9th, 10th and 11th was voted an unqualified success by the representative members in attendance from all points along the Pacific Coast. The meetings were held in the Oddfellows Hall at the corner of Hamilton and Pender streets, which was also the headquarters of the convention and members of kindred engineering societies, many of whom availed themselves of the invitation to register there and attend the proceedings. The convention committees were composed as follows:

General—R. F. Hayward (Chairman), E. M. Breed (Secretary), F. D. Nims, L. G. Robinson and J. R. Reid.

Paper—F. D. Nims (Chairman), D. P. Roberts and W. W. Fraser.

Transportation—E. M. Breed (Chairman), J. R. Reid, J Montgomery, E. R. Pease and H. W. Keefer.

Entertainment and reception—L. G. Robinson (Chairman), R. H. Sperling, J. A. Shand, W. V. Hunt, G. R. Wright and W. J. Lister.

Finance—W. McNeil.

On the opening day of the convention, the visiting delegates were accorded a civic welcome by Alderman Mahon in the absence of Mayor Baxter, and Mr. R. F. Hayward tendered the greetings of the local members, and also introduced Mr. Lightipe, of Los Angeles, as vice-president of the society, who presided throughout the proceedings. During the first afternoon session Mr. C. F. Uhden, chief engineer of Washington Water Power Company, of Spokane, Wash., read a paper on the "Effects of Ice Loading on Transmission Lines" prepared by Mr. V. M. Greisser, an electrical engineer with the same company. This was followed on the succeeding dates of the convention by five other papers, comprising the following: "Mountain Railway Electrification," by Mr. A. H. Babcock of San Francisco, chief electrical engi-

neer of the Southern Pacific Railway. The "Gulf of Georgia Telephone Cable," by Mr. E. P. Labelle and Mr. L. P. Crim, of the British Columbia Telephone Company, Vancouver. "A Modern Sub-station in the Coeur D'Alene Mining District" (Idaho), by Mr. J. B. Fiskin, superintendent of the Washington Water Power Company, Spokane, Wash. "Notes on Oil Circuit Breakers for Large Powers and High Potentials," by Mr. K. C. Randall, chief engineer of the switchboard department of the Westinghouse Electrical Manufacturing Company of Pittsburg, Pa. "Logging by Electricity," by Mr. E. J. Barry, electrical engineer for the St. Paul Tacoma Lumber Company, of Tacoma, Wash. The papers read at the regular daily sessions were supplemented on the evening of the 10th inst. by an interesting address at the Vancouver Progress Club on the topic "Some Features of the Panama-Pacific Exposition" from Mr. A. H. Halloran.

A note worthy feature in arranging the programme for the convention and one which was evidently popular with all those who were present, was the departure from the usual custom of placing a brief time limit for the hearing and discussion of papers, the decision to allow only six papers to be read during the course of the meetings, permitting an entire half day session in which to deal with each single subject. The popularity of this arrangement may be gauged from the fact that practically everyone out of the average daily attendance of over 100 members remained behind to take part in the discussions.

The attendance during the convention was another gratifying feature, everyone who could possibly spare the time from his usual daily duties being on hand at all sessions. The banquet in the Terminal City Club tendered to the delegates by the local convention committees at the close of the convention, was a most successful event, upwards of 150 engineers being in attendance, the visitors taking the opportunity to express their appreciation of the excellent manner in which all the arrangements in connection with the convention had been carried out.

On Friday, the 12th inst., the delegates, accompanied by a number of the Vancouver section, were the guests of the Western Canada Power Company on a trip of inspection to the company's plant at Stave River Falls, and on the following day the visitors availed themselves of the invitation of the B. C. Electric Railway Company to inspect that company's plant at Lake Buntzen.

Can Supply Power to Portage

A delegation composed of Mayor Taylor, Aldermen Richardson and O'Brien of the city council and J. J. Garland, president of the Board of Trade of Portage la Prairie, waited upon the members of the light and power committee of the city of Winnipeg with the object of discussing the possibility of securing a block of power from the latter city's power plant.

The necessary transmission line and sub-stations for the carrying out of this scheme is estimated to cost $250,000, and will, in all probability, if an agreement is reached, be built and maintained by the city of Portage la Prairie.

This is not the first time that the question of supplying Manitoba towns, other than Winnipeg, with power generated on the Winnipeg River, has come up. During the last few years there have been a number of rumours of such schemes but nothing definite has yet been done. Tenders have been received, however, for from 2,000 to 6,000 cedar poles, 45 ft. in length, 7 in. top, as per Idaho lumbermen's regulations, 2,000 to be delivered f.o.b., between Bird's Hill and Portage la Prairie at intermediate stations not later than November 15th, 1913; the balance of 4,000 to be delivered between Portage la Prairie and Virden at intermediate stations not later than March 15th, 1914.

Tenders for the above were received by H. V. Hudson, secretary and treasurer, Great Falls Power Company, Merchants Bank Building, Winnipeg.

Can Sell in St. Boniface

The question of the right of the city of Winnipeg to sell electric energy in St. Boniface for light, heat and power purposes came up recently before Commissioner Robson of the Manitoba Public Utilities Commission. Commissioner Robson decided that the city of Winnipeg had the right to sell electric energy in St. Boniface, that the public utilities commission had jurisdiction regarding the application and that the only point remaining to be settled was that of the distribution of poles, etc.

This application by the city for the right to supply light and power to a nearby municipality is the fourth which has so far been heard by the public utilities commissioner. The application has been granted in each case. It is expected that in turn all of the surrounding municipalities will receive the attention of Judge Robson in this matter.

Canadian Collieries, Limited

The Hydro-electric plant of the Canadian Collieries, Limited, on the Puntledge River, Vancouver Island, is now operating successfully. At this point there is a possible capacity of approximately 20,000 h.p., only half of which however is being developed at present. The forebay is some three miles above the power house and the water is carried by enclosed pipes, for the most part, of wood stave construction. The first section of pipes is 8 ft. in diameter, and 5,380 ft. in length; at this point the pipe divides by a Y into two pipes 6 ft. diameter, only one of which is being installed at present. The 6 ft. pipe has a length of 4,500 ft. when it again divides and the water is led by two 50-inch penstocks, the first 3,770 ft. of which are constructed of wood staves with steel bands and the last 660 ft. of steel pipe.

Two turbines of the re-action type have been installed, horizontal shafts, direct connected to generators of the revolving field type. The generator characteristics are 13,200 volts, 25-cycles, 3-phase, 500 r.p.m. The normal rated capacity of each turbine is 4,700 h.p. and of each generator 3,500 kw. Though the plant is only one half completed it is stated that the capital cost has not exceeded $70 per h.p. and that when it is complete this amount will be reduced to about $60. The machines operate under a static head of 350 ft.

Railway Operation at 2,400 Volts

A contract has just been awarded to the Canadian General Electric Company by the Canadian Northern Railway Company for the equipment required in connection with the Mount Royal tunnel and terminal system being constructed by the latter company at Montreal. The line is approximately four miles in length and the equipment will consist of seven electric locomotives, eight or more multiple unit control motor cars and generating, transforming and switching equipment. It might be mentioned in the same connection that the Canada General Electric Company were recently successful in securing the order from the Canadian Pacific Railway for the electrification of the Castlegar Branch of that railway, which is situated in the Kootenay Division. Heavy power locomotives are to be used in each case and the voltage adopted has been 2400 volts, which has been standardized by the General Electric Company and the Canadian General Electric Company for electric service of this nature.

The decision to introduce 2400 volt service into Canada follows the successful equipment of some 114 miles of line of the Butte, Anaconda & Pacific Railway. On this line 17 heavy electric locomotives are operating.

Calgary Power Co. Extensions

By Mr. A. G. McLeish

In former numbers of the Electrical News articles have appeared pertaining to the plants of the Calgary Power Company, including their new extensions and developments on the Bow River, about fifty miles west of Calgary. During the months June to September inclusive their engineers have made rapid strides in accomplishing a large proportion of the hydro-electric construction, estimated to cover a period of approximately one year. The power plant of this company was situated at Horseshoe Falls, Bow River, but in addition to further installations at this point a second development is well advanced at Kananaskis, about 2 miles up stream.

Development at Kananaskis Falls

Above the Kananaskis Falls, and at a point where the Kananaskis River joins the Bow, a horizontal ledge of hard-pan rock provides a suitable foundation for concrete building. This site was chosen for No. 2 dam. During the low-water winter season, a temporary water-run was cut through the rock and built up with concrete for the accommodation of stop-logs when necessary. A coffer dam was built extending toward the opposite bank of the river as far as the increasing flow of water would permit, and laying of concrete went on immediately. With the approach of warm weather in the spring of the present year, with a greatly increased flow from the glaciers, it proved impracticable to attempt to divert the whole stream through the temporary run-way; therefore a natural opening was left at the north bank of the river, the dam to be completed in the near future when the necessary abatement in water flow becomes apparent.

Concrete mixing has been done throughout by two one-cubic-yard steam-driven mixers, situated at one end of the dam, the concrete being hauled on dump-cars from mixers to destination. Sand and gravel was obtained for the whole work on the company's own premises, within a short run from the mixers. For assurance of obtaining a flawless and solid foundation for the dam a Calyx drill has been at work continuously, drilling, and filling up all crevices in rock beneath the dam.

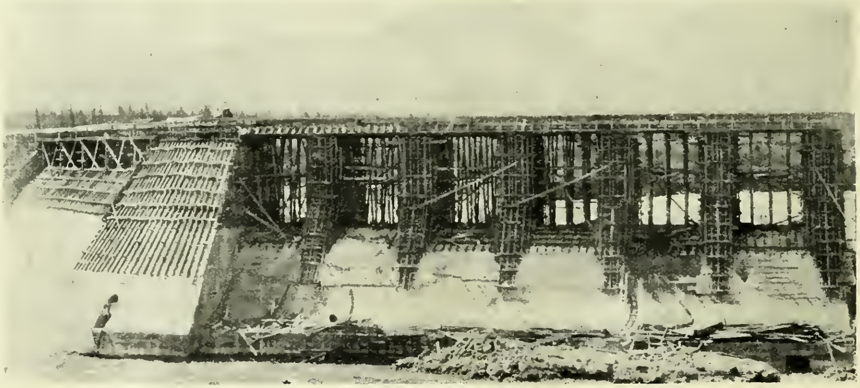
When completed the concrete structure will extend across the river a total length of 800 feet by 57.5 feet in height, built in eleven sections, or stop-log spill-ways. At present the dam is up to its final proportions, excepting the portion at the north end.

Excavation for power house, pressure and draft-tube tunnels and head-water canal is practically completed; the concrete casing in tunnels and draft-tubes is well under way and power house sub-structure is building. A concrete foundation is laid for a 90 ft. by 60 ft. main building, the lower 15 feet of walls also to be of concrete, above which it will be finished with large clay-brick. The head-water canal, encased with concrete from forebay to head works, will assume dimensions of 700 ft. long by 80 ft. wide at the top and 50 ft. at bottom by 19 ft. in depth. From the head works two short concrete penstocks 60 ft. long by 35 by 13 ft. cross-section at head gates, and 12 by 12 ft. at wheel case, will feed directly into the turbines. From the turbines water will be discharged into draft-tubes 30 ft. in length, and varying in cross-section from 9 ft. square at wheel pit to 13 ft. by 16 ft. at entrance of water into tail-race tunnels, whence it is carried down to the lower river. With this completed system a total effective head is obtained of about seventy feet.

Record progress has been made in all excavation work, facilitated chiefly by use of two steam shovels and three hoist derricks, as well as several pneumatic drills, etc. Two locomotives are in service for removal of rock and debris.

Power house foundation and sub-structure is planed and laid out for instalment in the near future of two vertical type Canadian Allis-Chalmers turbines of approximately 5,800 horse-power each, with Canadian Allis-Chalmers governors, to run two Swedish General Electric generators, 4,250 kv.a. There will be one 175 kw. 250 volt turbo-exciter and one motor driven exciter of the same capacity. All switching equipment will be installed by the Canadian Westinghouse Company including a vertical type remote-control switch board. Installation of power house equipment will be simplified by use of a forty-foot span, 50-ton crane, electrically operated.

Current will be generated in this station, as in No. 1, at 12,000 volts, and transmitted at the same potential over copper wire, three-phase circuits to the present Exshaw transmission line, which is also in process of reconstruction into a double pole three-circuit system.



Calgary Power Company, Kananaskis Falls.—Down stream side of dam.

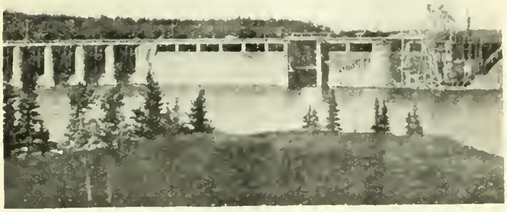
Extensions at Horseshoe Falls

To supply the constantly increasing demand for electrical energy a further extension is being added to No. 1 plant. The fourth penstock has been constructed by the company's own employees and a new 6,000 h.p. turbine installed by the Wellman-Seaver-Morgan Company, controlled by a Lombard governor. A fourth 4,500 kv.a. generator is being forwarded by the Canadian General Electric Company for immediate erection. For this increased capacity two 3,000 kw., three-phase transformers have been placed in operation by the Canadian Westinghouse Company, with additional necessary switching apparatus. No. 1 plant will now have a capacity of 18,000 horse-power and with the two plants combined a total capacity of 30,000 horse-power will soon be available.

Transmission and Switching

The present transmission system consists of two 55,000 volt lines, 50 miles in length, each of No. 0000 stranded alu-

minum cable carried on substantial wooden poles with cross-arm construction, serving the sub-station in the city of Calgary, and two 12,000 volt lines, 25 miles in length, of the same construction, serving the station at Exshaw, where transformers and synchronous apparatus are installed to obtain power at an operating voltage with good power factor. Under ordinary circumstances, the two 12,000 volt lines serving Exshaw will be carried by the new plant, and provision has been made in the switching equipment to enable this load to be transferred to the 12,000 volt busses at the present plant. In addition, outgoing feeders will be installed for the purpose of connecting the 12,000 volt busses of the two stations, enabling the new plant to feed the 55,000 volt lines to Calgary through the step-up transformers at the present plant.



Calgary Power Co., Kananaskis Falls.

The switchboard gallery is 19 feet wide, running the full length of 90 feet along the east side of the power house, and contains the station service, exciter, and remote control boards. Generator circuits and outgoing feeders are operated by remote control, electrically operated, circuit breakers installed in the high tension chamber. Owing to the necessity of handling two 12,000 volt incoming lines from the new plant, in addition to the Calgary and Exshaw out-going lines, the installation of three 12,000 volt busses and two 55,000 volt busses was provided for in the original layout of the present plant. Interconnection of the low tension busses provides for the operation of the outgoing lines from a combination of any of the four units in the present plant as well as from either or both of the two units in the plant now under construction, an arrangement of maximum flexibility. In order to handle the increased load on the high tension line, it is intended to erect two additional 55,000 volt transmission lines serving the Calgary sub-station. The survey for the first of these lines has been about completed, and the other will be surveyed at once. The route of these two lines will follow closely that of the most northern of the existing high tension lines. All switchboard and transformer equipment in the operating plant, as well as the switching apparatus for the new plant, was supplied and installed by the Canadian Westinghouse Company, Limited.

Mr. J. G. Glassco, general manager of the City of Winnipeg Light and Power Department, is at present in the east on business connected with the duplicate transmission line to be erected on the right-of-way of the present line. The original intention was to use standard braced towers exclusively in the construction of this line, but owing to late developments in the use of combinations of braced and flexible towers with their consequent monetary advantages it has been decided to more thoroughly investigate the claims of each system. Mr. Glassco will personally inspect a number of transmission systems in the United States and Canada.

Residential Street Lighting

By Mr. A. H. Winter Joyner

Street lighting during the last two and a half years has shown a remarkable improvement in appearance and a corresponding increase in efficiency. In Ontario there has been exceptional opportunity to effect such improvements as an incidental result of the co-operative plan of power distribution under the direction of the Ontario Hydro-electric Power Commission.

Any system of street lighting is a compromise between two extremes. Examples of these extremes may be cited in the case of a tungsten lamp installation. On the one hand a bare tungsten lamp of selected candle power may be suspended on a perfectly plain fixture without any attempt at ornamentation, such bracket being strong enough to require practically no maintenance, and above the lamp a radial wave reflector of large dimensions may be used, thus insuring the highest efficiency and good distribution of light. Such essential devices as ground insulators, etc. might be attached to the outfit so as to be quite secure but not at all of pleasing appearance. An example of the other extreme would be a highly ornamental bracket requiring an undesirable amount of maintenance, supporting a tungsten lamp and opal globe of sufficient density to absolutely obscure the outline of the filament. No doubt in this latter case the appearance of the fixture would be very pleasing but the useful illumination would be comparatively small.

A practical solution of the problem is the use of two or three different types of lighting units to suit the various localities. On the commercial streets good lighting efficiency is essential but with some attention to the artistic needs. In residential districts, pleasing appearance is very important with a due attention to efficiency and a general distribution of the light. On the other hand in an outlying district efficiency is practically the only factor to be considered, although at no time is it necessary to inflict extreme ugliness upon the citizens.

Fig. 1.

As a general rule small towns from a lighting point of view can be divided into three localities. First, the commercial streets, where the principal stores are located and where a brilliant and artistic effect is desired. In this section some form of cluster pillar lighting has been popular but certainly there appears to be very little either from an engineering or artistic point of view to recommend this for commercial street lighting unless all other poles are removed from the street. In the smaller towns it would seem more appropriate to get equal illumination results without so much expenditure. If the principal streets can be entirely cleared of overhead line construction, including trolley poles, telegraph and electric light poles, some form of electric light standard is, of course,

almost necessary and extremely appropriate. In most cases, however, it will be found that a single light unit, whether a tungsten or some of the higher efficiency types of lamp, will be much more appropriate for this class of street than the more ordinary and obtrusive five light cluster.

On the other hand, if poles cannot be moved from the main street the best way to treat the lighting problem is

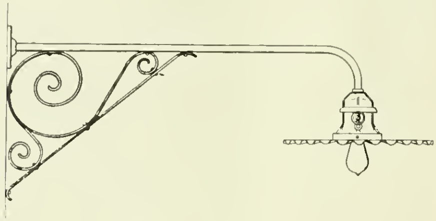


Fig. 2.

by the installation of suitably designed one or two light brackets installed on the existing poles thus escaping still further covering the street with obstructions whether individually artistic or not.

The second general division comprises those streets immediately adjacent to the commercial streets which are of some importance and often contain the public buildings, large residences, etc. As a rule the best way of treating these streets will be either to continue the same class of lighting as is used on the commercial main street or to carry out the general design in a single light unit, using a globe over the lamp and possibly adding a radial wave reflector if regard for low operating expense is desired. If poles have to be kept on these streets, then the fixture would consist of a bracket installed on the same.

The third division includes all the residential and outlying districts. Here it is necessary to use a bracket that

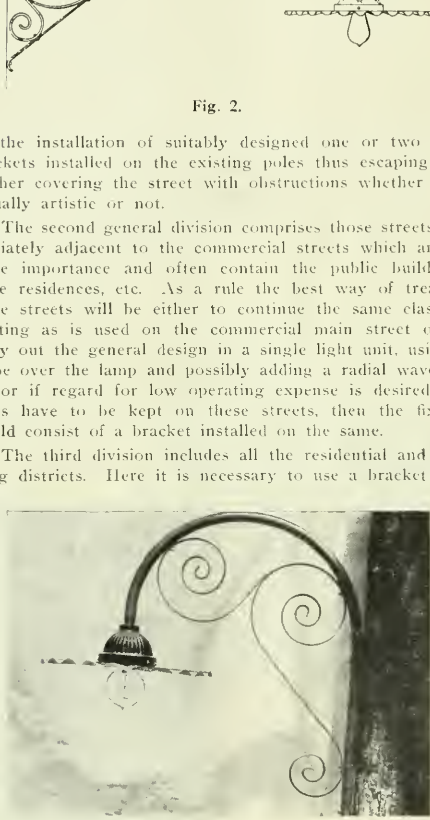


Fig. 3.

is strong but of good design with a fixture of good general appearance but which will cost very little to maintain and will give the highest efficiency and the best distribution of light. The bulk of the lighting being in this district the unit cost must be kept down to a minimum. These conditions are met by the use of a tungsten lamp of appropriate size suitably located on the pole and properly spaced, supported on a simple wrought iron or cast iron bracket and under a radial wave reflector.

A comparison of a few actual installations in Ontario towns will show modern systems which differ materially but have undoubtedly improved the local conditions and given great satisfaction to the citizens.

Fig. 1 illustrates a two-light bracket unit installed on the main street of Oshawa. Two series fixtures fitted with high efficiency ball globes are supported on a T-shaped bracket making a complete unit of pleasing appearance in the daytime and giving good lighting effects at night. The good alignment of these brackets is secured by special adjustable device which was found of great advantage in saving time when the brackets were being installed. There are a number of towns using practically this same type of fixture for their main business streets, including Barrie, Trenton, etc. Should the question of underground distribution be considered at any time in towns of this character such a fixture as this can be removed to the adjacent streets or used for boulevard lighting and some other form of pillar lighting installed in its place. In Oshawa and the above mentioned towns the streets in the immediate neighborhood

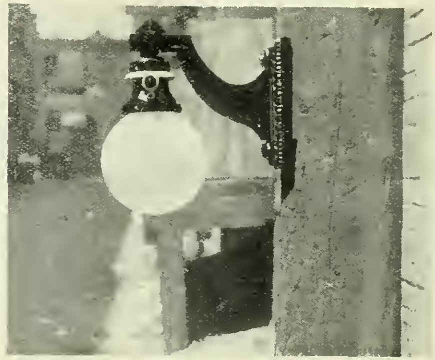


Fig. 4

of the principal thoroughfares are equipped with a single light unit having a globe of the same general design as the two-light fixture illustrated. The outlying districts have the type of unit recommended above for such localities as illustrated in Fig. 2.

A very pleasing variation from the ordinary kind of unit has recently been installed in the city of Brantford. Fig. 3 illustrates this unit. The fixture is of the multiple type and as will be noted it is fitted with the well-known Pemco reflector and a clear round bulb tungsten. Efficiency, artistic appearance and durability are combined in this fixture in a very effective manner. In Brantford these brackets are installed over the entire city with the exception of the principal down town streets, where pole top magnetite lamps are being used.

One other interesting installation is worthy of note, an entirely different design of bracket, Fig. 4, used in Paris. It is admirably adapted to the town. The bracket is of massive cast iron, finished in black baked enamel. The fixture is of the series type and the 80 c.p. tungsten lamps are enclosed in high efficiency 10-in. ball globes protected with globe rings, which are well worth the slight additional cost, as they reduce the breakage in glassware. These brackets are used in all parts of the town except on the main commercial streets, where a single light pillar is being adopted.

The Montreal Society for the Prevention of Cruelty to Animals are installing an electric cage for the instantaneous destruction of animals. The electrocution is effected by placing the animal in the electric cage, attaching a metal collar to its neck and closing the door. This act bring into operation a current of 1,200 volts, death occurring in 30 seconds.

Mercury Rectifiers and Magnetite Arcs

By Mr. L. Burpee

At the beginning of 1910 there were in operation in Canada, five Canadian General Electric fifty light mercury arc rectifier equipments requiring as many tubes. Since that time, or in the last four years, installations have increased at the rate of between 2300 and 2400 light capacity per year so that at present, equipments have been shipped aggregating approximately 9500 lamps and 237 tube capacity. In view of the general interest shown in this system it is perhaps timely to give a brief description of it and of the principles upon which it operates and to give possible explanations of some of the phenomena observed under actual operating conditions.

Both the station equipment and the arc lamp differ radically from earlier types of apparatus. The station equipment receives energy from the constant potential a.c. buses and delivers to the load circuit direct constant current of voltage depending upon the load. The magnetite lamp differs from its predecessors in that the light emanates entirely from the arc which is luminous throughout its entire length.

Station Equipment

In the eight or ten years that this apparatus has been in commercial operation the lamp has been changed only in minor details, though on the other hand the station equipment has undergone a considerable evolution. In the earlier forms, the various component parts of the latter were shipped separately and connected into the system at the time of installation. In these forms the constant current transformer was oil-cooled and the tube air-cooled. In the present form, known as the combined unit, shown in Figs. 1 and 2, the component parts, with the exception of the panel, are mounted on a common base and connected up before leaving the factory, effecting a great reduction in wiring and floor space. In this the constant current transformer is air-cooled, as will be seen, and the tube oil-cooled.

The principal parts of the station equipment are the constant current transformer, d.c. reactance, tube tank, rectifier tube, exciting transformer, static discharges and panel.

It is the function of the constant current transformer to transform constant potential alternating current to alternating constant current. It differs in construction only slightly from the well known C. G. E. transformers for series arc and incandescent street lighting. The difference lies in a tap which is brought out from the middle of the secondary winding which in this case, is the stationary coil to which tap the load circuit is connected. It differs, too, in operation in that but one half of the secondary is active at any instant.

The direct current reactance is connected into the load circuit between the load and the rectifier tube. It is placed here to protect the tube from line surges though its chief function is to act electrically as a fly-wheel does mechanically, that is to absorb energy at the peak of the wave and return it to the circuit at the low point, thus carrying the load over the electrical "dead centre" or the zero point.

The tube tank has a capacity of about 23 Imperial gallons of oil per tube. It is provided with cooling coils that the oil might be kept at the proper temperature and secure the best possible tube life and continuity of service.

The tube, Fig. 3, is a glass vessel containing about one pound of chemically pure mercury and is exhausted to a very high degree of vacuum. Its construction is well indicated in the figure. It receives from the secondaries of the transformer alternating constant current and rectifies it into direct constant current. The process of rectification is perhaps best described by referring to Fig. 5, the diagram of connections. Suppose for instance the current in the primary to be in the direction of a single-headed arrow. In the secondary it will be in the opposite direction as shown. It will pass through the secondary connection to the right hand anode of the tube, thence through the cathode and indicating lamp "L," the d.c. reactance, out to the positive of the load circuit and back to the centre of the secondary coil. With the reversal of primary, indicated by a double-headed arrow, there will be a corresponding reversal in the secondary and the left-half of the coil will become active, current passing through the left hand anode to the cathode, pilot lamp, d.c. reactance, and to the positive side of the load as before; thus with two half waves of opposite direction in the primary there have been

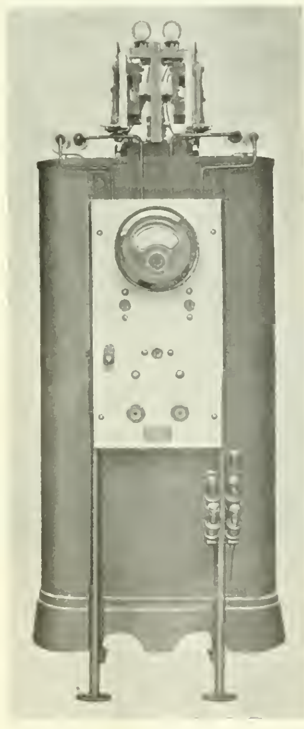


Fig. 1—Latest type mercury rectifier combined unit.

two waves in the load circuit in the same direction, that is, rectification has been accomplished.

The exciting transformer is a small transformer with a 110 volt primary coil which is connected to the terminals of a small exciting coil placed at the top of the middle leg of the main transformer. As will be seen later on, it is impossible to start the rectifier tube without some means of ionizing the mercury vapor. The exciting transformer is so designed that its secondary short circuit current, occasioned by tilting the tube at starting, cannot rise above a predetermined value which is only slightly above the actual current delivered in exciting the tube. It has three terminals corres-

ponding to those of the main transformer, two of which are connected to the starting anodes and one to the cathode.

The static dischargers in form, are not unlike lightning arresters. They are connected, as may be seen in Fig. 5 between the cathode of the tube and each anode and are designed to prevent the potential of the secondary circuit from rising to a dangerously high point, thus affording protection to the tube and to the transformer secondaries.

The Magnetite Lamp

The magnetite lamp is so constructed that the starting magnet coils are in circuit only long enough for the lamp to

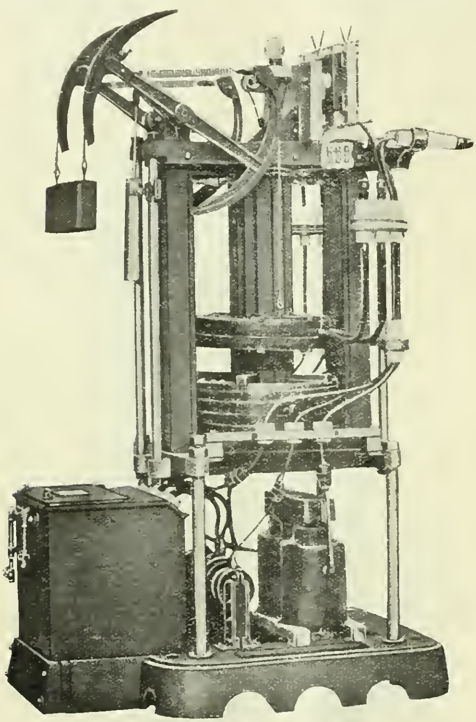


Fig. 2—Combined unit rectifier—casing removed

start or feed. The total losses are about 10 watts so that the electrical efficiency is very high. An internal automatic cut out affords protection in the event of an interruption of the arc for any reason whatever. The features which differentiate the magnetite from all other lamps are the electrodes. The upper is of pure copper rod within an iron sleeve. It is practically non-consuming requiring replacement but once every 2,500 hours in the 6.6 ampere lamp and every 6,000 to 8,000 hours in the 4 ampere lamp. The lower electrode consists of a thin sheet iron tube filled, principally, with magnetic iron oxide. It is guaranteed for a life per trim of 100 to 125 hours in the 6.6 amp. lamp and for 175 to 200 hours in the 4 amp. lamp. The internal concentric circle enamel reflector placed just above the arc is so designed that its effect, combined with the natural tendency of the arc to give its maximum light in a horizontal plane produces an almost ideal distribution. Reference to Fig. 6, curve A, shows that the candle power of the magnetite lamp attains a maximum intensity of 1,680 c.p. at 10 degrees below the horizontal while that of the direct current 6.6 ampere enclosed arc lamp is but 560 candle power or one-third of the former. The maximum candle power of the latter lamp is 680 at 40 degrees below the horizontal. Since the light falls off as the square of the distance from the source it will be seen that the distribution from curve A is vastly superior to that from curve B. In fact the illumination produced by the magnetite lamp at a horizontal distance of 143 ft. is equal to that of the carbon lamp at 83 ft. (both arcs 25 ft. above ground), although the consumption of energy in the two lamps differs little.

Operation

It has been shown above, how by means of a rectifier, two half waves of opposite polarity are changed into two of the same polarity. The operation of the unit as a whole, under varying loads will now be dealt with. This can probably best be done by referring to Fig. 4, the characteristic curve of a 4 amp., 4,500 volt, d.c. unit. It will be seen that when the load circuit is open or has infinite resistance, the voltage is about 46 per cent. above normal. If the resistance be gradually decreased the voltage will decrease correspondingly in practically a straight line inclined to the horizontal. This will continue until the secondary current has reached normal value, i.e., 4 amps. at which the primary coil, which has up to the present been resting on the secondary coil, that is, in full load position, will begin to float, due to the repulsion between the two coils. A further decrease in resistance will result in a decrease in voltage in a straight line but now perpendicular to the horizontal, there being no change in current. The latter will remain constant until the primary coil reaches the top of the transformer after which further regulation cannot take place. This will correspond to a voltage somewhat less than one-third of normal rating. Any further decrease in resistance will result in an increase in current with a decrease in voltage until short circuit is

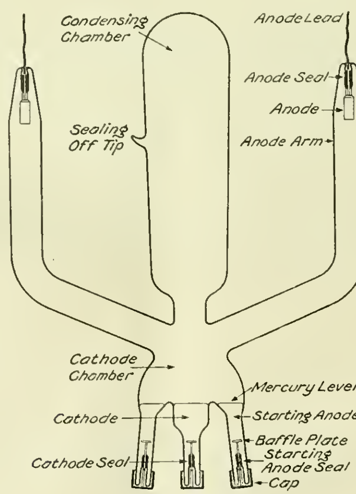


Fig. 3—Rectifier tube

reached, at which point the current will be between 50 per cent. and 60 per cent. above normal. On all rectifier transformers an 80 per cent. load tap is brought out for the purpose of obtaining high efficiency and power factor on light loads. The lower curve in Fig. 4 is the corresponding characteristic.

Phenomena

Considerable speculation has been indulged in in an endeavor to explain why it is that current at ordinary voltage

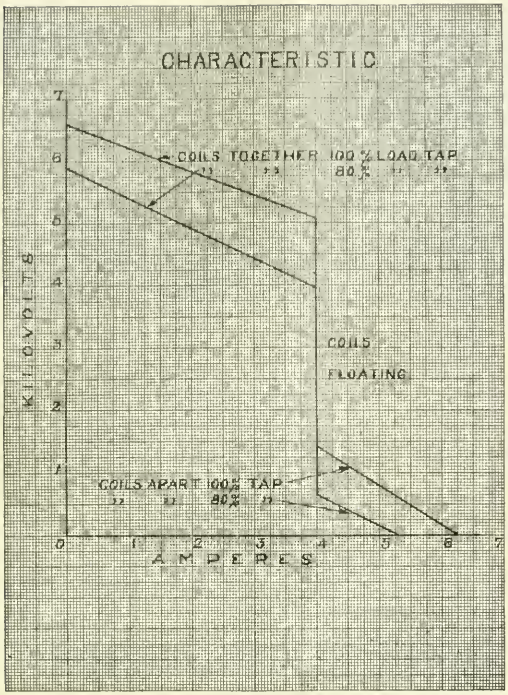


Fig. 4

pressures can pass through the tube in but one direction and how it is conducted between the anode and cathode. No theory, so far as the writer knows, has yet been generally accepted. Apart from theory, the following are interesting facts.

First, that a glass vessel exhausted to a high degree of vacuum offers a very high resistance to current in either direction.

Second, that the presence of mercury vapor, either cold or heated to a high degree, does not affect the situation.

Third, that once the arc is started as by the kick of an induction coil or by other means, the resistance in one direction falls to a very low point allowing a direct current to flow continuously with a potential of 20 volts or more.

Fourth, that the flow of current ceases the instant the arc blast at the mercury pool is interrupted and cannot be started again until the mercury vapor has been acted on by an auxiliary arc.

Fifth, that if an alternating current be superimposed upon a direct current already flowing, only that wave having the same direction as the direct current can pass through the tube.

Sixth, that the temperature at which a rectifier will operate is higher the lower the load voltage even though the current remain constant.

Seventh, that the lower the load voltage the longer will be the average life of tubes.

Eighth, that continuous operation produces a condition of vacuum which, though still good, renders the tube inoperative.

Ninth, that the placing of bell-shaped metal caps commercially known as "static protectors," over the anodes, overcomes the condition mentioned in the last paragraph and renders the tube operative.

Tenth, that when a tube equipped with static protectors again acquires a condition of vacuum under which it will not operate, it may be remedied by boiling and allowing to rest for several months.

The phenomena mentioned in paragraphs 8, 9 and 10 may be explained as follows:

In the manufacture of the tube an effort is made to get as high a vacuum as possible. Every tube is tested under full load conditions and carefully examined after test before being placed into stock so that when shipped it is known to be thoroughly exhausted and in first-class condition. There is, however, apparently a small amount of gas trapped in the glass walls, graphite anode and the mercury, which is only liberated after continued operation under approximately full load conditions. When the tube cools during the day the liberated gases are absorbed by the spongy graphite anodes. Upon starting up again the first rush of current causes the anode to heat, driving out the gas which becomes positively charged. Upon reversal of the current the anode in question becomes negative and as a consequence the positively charged particles of gas adhere to it. In time the amount of gas liberated from the walls, etc., becomes sufficient to make a thin layer over the entire surface of the anode, cutting it off from contact with the ionized mercury vapor, so that upon the next reversal of current, that is when the anode becomes positive again, the arc will not start, though the pressure across the tube is 14,000 volts.

Static protectors approximate a short hollow conductor. It is a well known fact that inside a perfect hollow conductor no electric forces (repulsion or attraction) exist, therefore with protectors placed over the anodes of the tube the particles of gas will not be attracted to the anode and will, therefore, be free to mix with the mercury vapor which

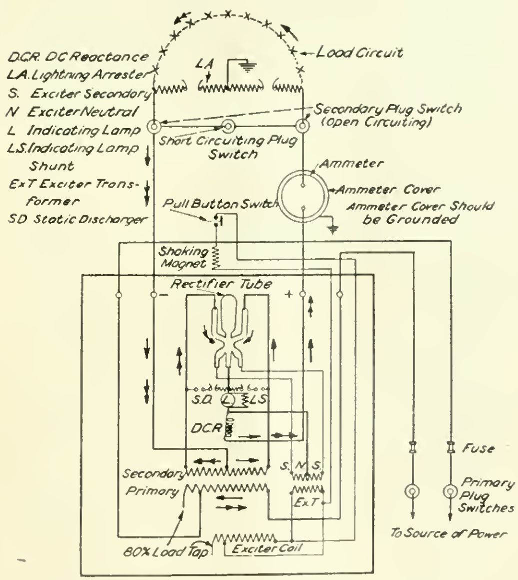


Fig. 5—Connections of single tube rectifier

probably carries them into the condensing chamber during operation, only to be reabsorbed by the anodes when the tube cools again.

The tube will continue to operate in this way for a considerable time with perfect satisfaction. There are, however, deposits forming all the time on the walls which gradually absorb the gases which have previously been giving trouble and raise the vacuum to such a high degree that the tube

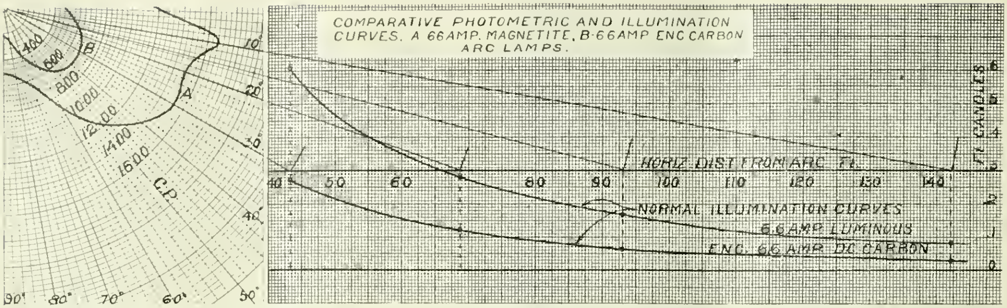


Fig. 6—Comparative photometric and illumination curves—6.6 amp. magnetite and 6.6 amp. enclosed carbon arcs.

again becomes inoperative. By a rest of several months or by gradually heating the tube to between 200 and 300 degrees centigrade, the compounds are broken down and the gases are freed, lowering the vacuum somewhat and restoring the condition necessary to operation.

Performance

Rectifier tubes are guaranteed for an average life of 500 hours but careful operators who have paid attention to the use of static protectors and to washing, boiling and resting their tubes, have succeeded in getting an average life, much above that guaranteed. One installation in the West consisting of thirteen 50-light, 4 ampere single tube outfits, reports an average life on all tubes since the beginning of operation, three years ago, of 1,330 hours with but half of the tubes out of commission. A second installation in the East consisting of two 75-light, 6.6 ampere outfits reports an average life of 2,500 hours on all tubes used in two years with but three out of commission. A third installation reports an average life for 75 tubes on the premises, of 2,600 hours, all of which are in operation or resting for future service. Reports also show that the life of the electrodes of the magnetite lamp is considerably above the guaranteed figure.

Personal

Mr. John Pearson, formerly assistant superintendent Hamilton Street Railway Company, has been appointed superintendent.

Mr. W. A. Lewis, Winnipeg manager Dawson & Company, Limited, is spending a month in the east and will take in the street railway convention in Atlantic City.

Mr. Thomas Rodger has been appointed supervisor of plant with jurisdiction over all matters appertaining to the telegraph and telephone traffic of the Grand Trunk Railway system, with offices at Montreal.

Mr. F. Jno. Bell, general manager of the Canada Wire and Cable Company, is spending some weeks on the Continent. Mr. Bell is accompanied by his wife and daughter and so is making his trip a combination of business and pleasure.

Mr. Arthur L. Mudge, chief engineer Midland Construction Company, sailed on October 4th from Montreal on the White Star-Dominion S.S. Canada, and expects to be in England for several weeks. Mr. Mudge is evidently trying to get as far away from business as possible as there are practically no water power developments in England to engage his attention. We trust he will enjoy to the fullest extent his well earned holiday.

Mr. C. J. McCuaig has been appointed honorary lieut.-colonel of the Fifty-Third Regiment of Sherbrooke. Mr. McCuaig, who is president of the Sherbrooke Railway & Power Company and a director of the Ottawa Light, Heat & Power Company, is also behind the Southern Canada Power Company, just incorporated with a capital of three million dollars, and which is understood to have been formed for the purpose of developing electrical enterprises in the Eastern Townships of Quebec.

Obituary

After an illness of two weeks, Mr. James Ross, C.E., the prominent street railway promoter, director, and manager, died in Montreal on September 20, from heart failure, aged 65. Probably no man in Canada took a more important part in the direction of electric railways than Mr. Ross, although of late years he has not been so active in this connection. Mr. Ross was a Scotchman by birth, and after spending some years in Great Britain and the United States as an engineer, came to Canada. He completed, as a contractor, several important railway jobs, and in 1892, in conjunction with Mr. William Mackenzie, purchased the Toronto railway from the city of Toronto, and rebuilt it, converting it into an electric line. In the same year he re-organized the Montreal Street Railway, which was changed into an electric line. He also converted in a like manner the street railways of Winnipeg and St. John. With Mr. Mackenzie and others in 1897, he secured a charter and franchise from the Government of Jamaica to build electric tramways on the Island.

Mr. Ross was at various times vice-president and managing director of the Montreal street railway; vice-president of the Toronto street railway; president of the Winnipeg and St. John street railways; president of the Dominion Bridge Company, and director of the Canadian General Electric Company.

At a conference held at the beginning of September between the management of the B. C. Electric Railway Company and committees from the various unions concerned in the agreement covering wages and working conditions recently under consideration, the final details of the new agreement were settled and the document signed by both parties. The agreement is to run for two years and covers the employees engaged in the operation of the company's railway department on both the mainland and Vancouver Island. An arbitration committee board was established under the Industrial Disputes Act and consisted of Judge Murphy, Mr. H. O. Alexander (for the Company) and Mr. Cotsworth (for the employees). The minimum rate of 22 cents per hour has been raised to 27 cents but the maximum of 35 cents remains unchanged. This latter rate we believe represents the highest paid by any privately operated railway company in Canada.

Correct and Distinctive Store Illumination

By Clarence L. Law and A. L. Powell

If one pauses to analyze retail places of business as a whole, it becomes evident that a convenient and complete classification may be made as follows: ordinary small stores, large dry goods and department stores, and high grade shops.

The authors treated the first of these classes in a paper presented at the last convention of the Society; they realized that high efficiency of light utilization, low initial cost of installation, low maintenance and simplicity were the determining factors. It seemed desirable to suggest a standard practice, and an attempt was made to do this on the basis of averages obtained from an investigation of a large number of stores of this class. Some criticism was elicited to the effect that this scheme would produce a monotonous condition, but the fact still remains that artistic appearance cannot be had cheaply, and, due to the small profits earned by a store of this sort, the amount spent for lighting is, of necessity, small.

In the large store, efficiency and artistic appearance become more nearly balanced. Artistic lighting implies good diffusion; and with the present commercial illuminants, this cannot be had without some absorption of light. The merchant can afford to spend a relatively larger sum for lighting than could be spent by the small storekeeper, and some sacrifice of light is made to obtain better diffusion. The store should have a harmonious system of lighting for the main parts of the entire building, yet there are some parts which are, in reality, shops, and should be so treated. The general requirements for department store lighting have been discussed several times in the Transactions of the Society, and there is no need for their repetition in this paper.

A high grade shop should be considered quite differently from the monotonous store which is so common in large cities. Unlike a small store, it should be considered individually and with respect to its particular line of business. This shop is, as a rule, small, handsomely and lavishly furnished, splendidly finished to the minutest detail, and located in the most fashionable section; it handles only the best of goods (frequently imported) and sells to a discriminating class of customers. The proprietor or manager is willing to spend large sums for the right equipment and maintenance. The profits for each individual piece of merchandise sold are undoubtedly greater than in other stores, and therefore, more money can be spent for individuality of equipment. Artistic appearance is the predominant factor, and, therefore, a distinctive system of lighting is necessary, efficiency of the installation being a secondary consideration.

It should be the aim and desire of shopkeepers of this class to interest and attract prospective customers, making them permanent habitues of their stores. Some definite architectural scheme should be carried out or symbolism expressed. Many stores show the influence of the personality of the proprietor, and often such details as the dress of the sales force are in harmony with a certain predetermined plan.

Among the points which should be given consideration by a shop proprietor in planning a distinctive store, may be mentioned the following: Design of the exterior; woodwork of the interior; color of walls and ceiling; finish of show cases; floor covering; finish and type of lighting fixtures, glassware and lamps.

Numerous examples of distinctive store lighting have undoubtedly come to the attention of every one, but a description of a few which the authors have observed may indirectly suggest schemes which will prove of benefit and aid in the advancement of the art of lighting. In last year's paper, the quantitative element in designing the lighting was discussed. A number of stores were grouped under one heading, but with the case in hand where individuality of stores of any one type is the essential, it is necessary to use the "case" system, illustrating by example.

¹ Read before the I. E. S. Convention, Pittsburgh.

Toy Store

An effective lighting system of a toy store may be seen in F. A. O. Schwartz's store on Fifth Avenue, New York City. The building is of modern construction with a high ceiling supported by pillars. The entire interior, including walls, ceiling and show cases, is finished in white, affording an excellent background for the varicolored toys on exhibition. The store was formerly lighted by nernst lamps with massive ornamental housings finished in gilt. These were of Renaissance design, and in keeping with the capitals of the columns in the main room. The heart-shaped nernst globe was replaced by a 14 in. (35.36 cm.) opalescent glass, acorn type diffuser, and 400-watt clear tungsten lamps were used. Diffusion is good and shadows from pillars and overhanging shelves are minimized.

Store	Window
Length 145 ft. (44.20 m.). Width 41 ft. (12.50 m.). Approximate area 6,000 sq. ft. (557.42 sq. m.). Ceiling height 17 ft. (5.18 m.) Lamps 12 ft. (3.66 m.) from floor. 15 400-watt, 4 250-watt clear tungsten lamps. Total wattage 7,000. Watts per sq. ft. (0.30 sq. m.) 1.2.	60-watt bowl frosted tungsten lamps set in recessed mirrored pockets at front edge of window, spaced about 3 ft. (0.914 m.).

Jewelry Store

Richness and splendor are symbolized by jewels and, therefore, the shop dealing in these, should be magnificently finished. The store of E. M. Gattle, on Fifth Avenue, New York, can well be used as an illustration. All of the show cases and furniture are of mahogany; immense gray marble columns and pilasters with gold capitals support a paneled ceiling, which is also of mahogany finish. The parts of the side walls not occupied by window space are a green tint, decorated in gold. The floor is of oak in parquet style. Light is furnished by eighteen shower fixtures, verde finish, using 40-watt all frosted round bulb tungsten-filament lamps, and in the paneled recesses in the front part of the store are eight cut glass hemispheres, accommodating two 25-watt clear tungsten lamps each. A high wattage is necessary with this system in a room of this style, as the reflection coefficients of the ceiling and walls are very low.

Store	Window
Length 78 ft. (23.77 m.). Width 38 ft. (11.58 m.). Area 2,960 sq. ft. (274.99 sq. m.). Ceiling height 13 ft. (3.96 m.) Lamps 10 ft. (3.04 m.) from floor. 220 40-watt round bulb all frosted 16 25-watt clear tungsten lamps. Total watts 9,200. Watts per square foot 3.1.	2 aluminium finish trough reflectors. 25-watt tungsten lamps spaced about 10 in. (25.4 cm.). Backing of window green plush.

Toggery or Haberdashery Shop

As this class of store caters entirely to men, the store

fittings should not be radical to any appreciable extent. Neatness, simplicity, and up-to-date appearance should characterize the shop. The lighting system must be quite efficient, as a high intensity of illumination is desirable.

The installation of one of the shops of Weber & Heilbroner on Broadway, New York City, conforms excellently with the above requirements. Six-arm brush brass fixtures of well balanced proportions are used with clear 100-watt tungsten lamps and opalescent bowl shaped reflectors. Show cases, counters and woodwork are of polished mahogany; ceiling smooth white plaster; walls above shelves covered with green burlap, and floor of hard wood. The window trim is of circassian walnut, forming an excellent contrast to the dark blue velvet backing for the goods on display. A white fixed shade, extending to within six feet (1.83 im.) of the sidewalk level, serves as a valance.

Store	Window
Length 69 ft. (21.03 m.). Width 18 ft. (5.49 m.). Area 1,342 sq. ft. (124.77 sq. m.). Ceiling height 13 ft. (3.96 m.) Lamps 10 ft. 6 in. (3.20 m.) from floor. 30 100-watt clear tungsten lamps. Total watts 3,000. Watts per square foot 2.4.	100-watt clear tungsten lamps. Concentrating prismatic reflector. Spaced 14 in. in a row along center of false ceiling.

Millinery

Since Paris is the seat of fashion, to create the proper atmosphere, the display room should be "Frenchy" in character. Mme. Bruck's shop on West Fortieth Street, New York City, may be taken as an example. White show cases, covered with mirrors line the walls, and the dainty furniture is all finished in white enamel. White has the advantage that it does not "clash" with the colored materials of the hats and tend to divert the attention from the goods on display. The ceiling is of smooth, white plaster and a border of satin finish wall paper matches the old rose Wilton carpet and silk window hangings. Two ten-light brass finish shower fixtures with bowl-frosted tungsten lamps surrounded with crystal beaded glass, furnish general illumination. Localized illumination at the mirrors is supplied by side wall brackets, brush brass finish, Empire style, equipped with bowl-frosted tungsten lamps, shielded by crystal and old rose beaded shades. A few plants add to the attractiveness of the room.

Store	Window
Length 40 ft. (12.19 m.). Width 12 ft. (3.66 m.). Area 480 sq. ft. (44.59 sq. m.). Ceiling height 10 ft. (3.04 m.). Lamps 9 ft. (2.74 m.) from floor. Total watts 750. 30 25-watt bowl frosted tungsten lamps. Watts per square foot 1.5.	25-watt clear tungsten lamps in concentrating prismatic reflectors on 2 ft. centers. 3 25-watt tungsten lamps in crystal fixtures in center of window. 2 sidewall brackets, cut glass shade and 25-watt tungsten lamps.

Candy Stores

One of the newest and most attractive of New York's Fifth Avenue stores is that of Schrafft. A combination of semi-indirect and totally indirect illumination is used. The front portion of the store serves as a shop and is lighted by five three-light carved alabaster bowls suspended from the ceiling by silk-covered supports, and four one-light bowls, two on brackets and two on short pillars. The ceiling here is tan decorated with raised gold figureing; walls are elaborately decorated, with red, green and blue on a neutral backing. Show cases are of circassian walnut; pillars and floor of marble. A number of small decorative standards are used to illuminate the counters. The rear half of the store is used as a lunch room. In the center of this room is what is apparently a fern-covered urn. This contains a white enamelled reflector and a cluster of clear lamps, the light from which is directed to the cream colored ceiling and walls, lighting the room indirectly.

Store	Window
Length 74 ft. (22.55 m.). Width (average) 17 ft. (5.18 m.). Area 1,200 sq. ft. (111.48 sq. m.). Ceiling height 14 ft. (4.27 m.). Lamps 10 ft. (3.05 m.). 5 150-watt clear tungsten lamps. 4 40-watt clear tungsten lamps. 15 60-watt clear tungsten lamps. Total watts 1,810. Watts per sq. ft. 1.5.	Finished in circassian walnut; roof recessed with mirrored pyramidal reflectors and 25-watt clear tungsten lamps installed in squares on 18 in. centers.

Delicious sweets of great variety originate in the Far East, and an Oriental scheme of decoration for a candy store is, therefore, often appropriate. In Page & Shaw's Fifth Avenue Shop the window is partially covered with a delicate tracery of red, green and blue leaded glass; at night this is accentuated by illumination from lamps in the ceiling of the window. Three metal and art glass hanging fixtures are also part of the window equipment. Free use of the primary colors is made in the decorating of the walls and ceilings of the store with conventional Moorish figures. The floor is of composition, red and white mosaic. It can be safely said that no two of the interior lighting units are alike. Oriental metal and colored glass domes, pottery vases lighted from within and silk-covered lanterns furnish a very low intensity of general illumination, with a higher value on the counters and show cases.

The cashier's desk is surrounded by leaded glass made in the form of a miniature Turkish house, the whole surface of which is illuminated by a number of line source tubular tungsten-filament lamps concealed in its interior.

Store	Window
Length 30 ft. (9.14 m.). Average width 15 ft. (4.57 m.). Area 450 sq. ft. (42.8 sq. m.). Ceiling height 10 ft. (3.05 m.). Lamps 5 to 7 ft. (1.52 to 2.13 m.) from floor. Total watts 900. Watts per square foot 2.0.	Roof recessed with mirrored pyramidal reflectors; one ft. centers; clear 16 c.p. round bulb carbon lamps; 2 60-watt all frosted round bulb and 3 25-watt regular tungsten lamps in hanging lanterns

Grocery Store

A neat, attractive display will cause trade to flock to the store which is properly arranged. Cleanliness is a very important point to remember. There is no demand for a system of decoration for this class of store, but the walls, pillars and ceiling should have frequent painting. A dark wainscoting, the color of the shelves and show cases, with neutral walls and ceiling, makes an attractive combination. Almost any lighting unit which is neat and inconspicuous will serve.

Store	Window
Length 70 ft. (21.33 m.). Width 40 ft. (12.19 m.). Area 2,800 sq. ft. (232.25 sq. m.). Ceiling height 14 ft. (4.27 m.). Lamps 11 ft. (3.25 m.) from floor. 10 250-watt tungsten lamps. Total watts 2,500. Watts per square foot 0.9.	100-watt clear tungsten lamps in concentrating prismatic reflectors spaced 2 ft. 6 in. (0.76 m.).

D. M. Welch & Son's store in New Haven, Conn., serves as an illustration of the above requirements. The counters

and show cases are of hard wood, natural finish; the trim is dark green; and the ceiling and walls are painted a light tint. Neatness is particularly characteristic. Two hundred and fifty watt tungsten lamps, in totally enclosing prismatic reflectors are used for general illumination. The unit is efficient and a satin finished lower half provides excellent diffusion. A short brush brass chain with canopy serves as the fixture.

Tea Room

Coziness is the keynote of success of these establishments. A number of years ago a young woman started in a small way to sell home-made candy and pastry among her friends. Her energies soon developed into a methodical business system, and her products sprang rapidly into favor, with the result that "Mary Elizabeth" has branch shops in many of the large cities. Her New York store located on Fifth Avenue, is finished in white on the outside, with her facsimile signature in black serving as a sign.

The shop itself is modelled after a New England interior of fifty years ago; the ceiling is low and finished in white plaster; the floor of white boards is painted a dark yellow and covered here and there with rag carpet "runners." The tea room proper is in the rear. On the right is an old fashioned fire place, and on the left a number of "stalls" similar to those found in taverns of bygone days. Small tables, covered with spotless linen, and gilt chairs are arranged in an attractive manner. Shelves, counters and windows are trimmed with dainty white material.

Light is furnished by tungsten lamps in shirred silk shades which have a slight touch of color. Sixteen of these are attached to ceiling outlets and eight are on wall brackets.

The atmosphere of the room is extremely inviting and the scheme of decoration well executed.

Store
Length 62 ft. (18.90 m.).
Width (average) 18 ft. (5.49 m.).
Area 1,110 sq. ft. (103.11 sq. m.).
Ceiling height 8 ft. (2.44 m.).
Lamps 7 ft. (2.13 m.) from floor.
24 40-watt clear tungsten lamps.
Total watts 960.
Watts per square foot 0.9.

Window
40-watt tungsten lamps in shades as used in the store; row in the center of ceiling; 2 ft. (0.61 m.) centers.

Shoe Store

Most stores of this class have a center bench arrangement, the entire wall space being covered with boxes on shelves. A room of medium width will require at least two rows of units to give satisfactory illumination on the labels on the boxes and at the foot rests where the shoes are fitted and inspected.

A particularly novel layout is that of Frank Brothers' Fifth Avenue (New York) shop. Entering from the street, one passes into the rotunda about 16 feet in diameter, the dome of which is supported by Corinthian columns. The floor is of mosaic marble and the ceilings, cream colored, with raised plaster decorations. Show cases, with attractive dressings, are grouped about the room. Suspended from the center of the dome is an ornamental inverted fixture containing eighteen lamps. This consists of six diffusing glass globes, pressed into the form of huge shells; below these are four round bulb carbon lamps enclosed in amber beaded glass.

The store proper is rectangular in shape and a balcony 6 feet (1.83 m.) wide extends completely around the interior. The cream colored ceiling beneath the balcony is divided by beams into squares. In the center of each square is a lighting fixture consisting of five pieces of pearl-like glass in the form of a large shell; a 10-watt clear tungsten lamp is located above each shell. At the base of the shell is a 25-watt round bulb all frosted tungsten lamp.

On each pillar from the balcony to the ceiling are located two two-arm brass brackets with clear gem lamps in roughed glass spheres. These serve to light the balcony and the center portion of the store proper.

The oak parquet floor is partly covered with rugs; the furniture is leather covered and the showcases and shelves are of mahogany.

Store
Length 64 ft. (19.5 m.).
Width 24 ft. (7.32 m.).
Area (main floor) 1,540 sq. ft. (143.07 sq. m.).
Height under balcony 8 ft. (2.44 m.).
Height above balcony 10 ft. (3.05 m.).
17 25-watt round bulb tungsten lamps.
85 40-watt clear tungsten lamps.
64 50-watt clear Gem lamps.
Total watts 7,000.
The value of watts per sq. ft would be of little significance, as two types of lamps are in use, and also both the balcony and main floor are lighted.

Windows
Mirrored trough reflector with 50-watt Gem lamps, outlets on 9 in. centers.

Antique and Curio Shop

In many cases the lighting requirements of an antique store are similar to those for a high class furniture store, that is, a low intensity of diffused light suffices. Exposed light sources are very objectionable, as the polished surfaces show the reflection and glare is to be deplored in viewing the rare pieces on exhibition. Quite often the lighting units themselves are "objects d'art." Such is the case in the shop of Lewis & Simmons, where hand carved alabaster bowls with clusters of clear lamps furnish semi-indirect illumination.

The white ceiling, walls covered with dark red velvet and tan velvet carpet, make a good color combination for displaying the goods by contrast.

Store
Length 48 ft. (14.63 m.).
Width (average) 13 ft. (3.96 m.).
Area 630 sq. ft. (58.57 sq. m.).
Ceiling height 14 ft. (4.27 m.).
Lamps 8 ft. (2.44 m.) from floor.
20 40-watt clear tungsten lamps.
Total watts 800.
Watts per square foot 1.3.

Window
Mirrored trough reflector with 25-watt clear tungsten lamps spaced 8 in. (0.20 m.) apart along the top of windows, and upright at the two sides to a height of about 4 ft. (1.22 m.).

Book Store

Scribners' new store, Fifth Avenue, New York, is an excellent demonstration of a carefully planned and well-executed scheme of lighting. The ceiling of the main bay is vaulted and is of light gray sandstone with white plaster panels. This is lighted by means of line source tungsten lamps (approximately 25 watts per foot) the reflectors being located above the moulding running around the cove. Fourteen opalescent glass bowls, equipped with clusters of three lamps

Store (main bay)
Length 98 ft. (29.87 m.).
Width 28 ft. (8.53 m.).
Area 2,740 sq. ft. (254.5 sq. m.).
Ceiling height (maximum) 30 ft. (9.14 m.).
Lamps 9 ft. (2.74 m.) from floor.
128 35-watt tubular tungsten lamps.
42 40-watt clear tungsten lamps.
Total watts (approx.) 7,580
Watts per square foot 2.8.

Windows
No special lighting, as the windows extend to the top of the arch and the whole store is a flood of light.

each, hung from the ceiling by long brass rods, furnish a feature which seems desirable, viz., a visible source of illumination. The book racks and balconies in the side bays are lighted by 60-watt clear tungsten lamps in opalescent bowl-shaped reflectors. Paintings on the rear wall are lighted by individual mirrored trough reflectors equipped with 25-watt clear tungsten lamps on one foot centers. The entire front of the store is of plate glass, thus furnishing an excellent supply of daylight, and the cases and shelves being of light oak give the room a most cheerful appearance.

Ladies' Wear

This type of shop is really divisible into two classes; namely, general and specialized.

As an example of the first class, the Fifth Avenue (New York) store of J. M. Gidding, may be given a little attention. The lighting units are of the "sunburst" type, consisting of 6 regular and 6 round bulb, all-frosted tungsten lamps below a gilded composition plate, all suspended by a single chain. The fixtures are pleasingly harmonious with the cream colored ceiling and delicate gold lining. Show cases and woodwork are of magnificent circassian walnut, which blends well with the rich carpet of green and tan. The wall visible above the dressing room is largely covered with gilt figures.

Store	Window
Length 55 ft. (16.76 m.). Width 48 ft. (14.63 m.). Area 2,640 sq. ft. (245-25 sq. m.). Ceiling height 12 ft. (3.66 m.). Lamps 9 ft. (9.74 m.) from floor. 90 20-watt all-frosted tungsten lamps. 90 25-watt all-frosted tungsten lamps. Total watts 4,050. Watts per square foot 1.5.	Mirrored trough reflector with 25-watt tungsten lamps on 9 in. centers. White false ceiling, with two alabaster carved bowls, equipped with 6 40-watt tungsten lamps each, are suspended from this. Base and trim of window circassian walnut.

The specialized ladies' wear shop is exemplified by the shop of W. B. Crocker, which handles mourning goods exclusively. The scheme of decoration is very appropriate. As one observer remarked, "A sombre cheerfulness fills the room." A rich gray carpet is but a shade darker than the wall covering, which, in turn, matches the woodwork of the show cases and trim. The chairs are of gray oak and tables of wicker work. The ceiling is white, and suspended from this by long chains are four seven-light and one fourteen-light shower fixtures, dull silver finished. Low wattage, bowl-frosted tungsten lamps are used with diffusing shades.

Under the balcony at the rear of the store are full-length mirrors. Localized illumination is provided at each by a 25-watt all-frosted round bulb tungsten lamp. In the front portion of the store, the general illumination is supplemented by two-arm brackets similar in finish and equipment to the overhead units.

Store	Window
Length 76 ft. (23.16 m.). Width 16 ft. (4.88 m.). Area 1,210 sq. ft. (112.4 sq. m.). Ceiling height 18 ft. (5.48 m.). Lamps 10 ft. (3.05 m.) from floor. 60 15-watt bowl-frosted tungsten lamps. 18 25-watt round bulb tungsten lamps. Total watts 1,390. Watts per square foot 1.15.	Mirrored trough reflectors equipped with 50-watt Gem lamps on 9 in. centers. Woodwork gray. Mirrors at side. Beaded crystal hemisphere set in center of the ceiling.

Restaurant

There seems to be no definite practice with regard to the lighting of rooms of this nature. Some proprietors desire a great flood of light and the attendant sparkle as produced by crystal chandeliers; others demand a soft, well-diffused, low general illumination supplemented by localized table lamps. Bergfield's restaurant, on Broadway, New York, is an example of lighting with the latter idea of proper lighting. Totally indirect single unit, mirrored reflector lighting units of composition moulded into an Egyptian design are used. Mirrors are set into the wall panels, and above each is a two-arm verde finished bracket with low-wattage multiple lamps and silk shades. The wood work is cream, with gold decorations; ceiling white; wall panels old rose, satin finish; chairs mahogany finish, and the carpet a neutral green.

Store	Store
Length 77 ft. (23.47 m.). Width 27 ft. (8.23 m.). Area 2,080 sq. ft. (193.23 sq. m.). Ceiling height 13 ft. (3.97 m.). Lamps 9 ft. (2.74 m.) from floor.	5 250-watt clear tungsten lamps. 4 100-watt clear tungsten lamps. 68 10-watt clear tungsten lamps. Total watts 2,330. Watts per square foot 1.1.

Delicacies

The Specialty Shop in Boston, has a dark wainscoating about 6 feet (1.83 m.) high; above this the walls are divided into panels; in each of these panels is set a heraldic design, which has been adopted by the proprietor as a trade mark. The ceiling is white, glazed, and divided into polygons by the moulding. The show cases and counters are divided into panels which are practically replicas of the wall panels. The floor is mosaic tile. The lighting system is remarkably in accord with the general scheme. Between adjacent panels is a torch fixture with an upright lamp and diffusing ball. Counter standards, wall brackets and four-arm ceiling fixtures carry bowl-frosted tungsten lamps and pyramidal art glass shades which are finished to match the counter and wall trim. A most pleasing harmony is secured.

Store	Store
Length 72 ft. (21.94 m.). Width 40 ft. (12.19 m.). Area 2,880 sq. ft. (267.55 sq. m.). Ceiling height 20 ft. (6.09 m.). Lamps 18 ft. (5.48 m.) from floor.	25 60-watt tungsten lamps. 14 25-watt tungsten lamps. Total watts 1,850. Watts per square foot 0.65.

Conclusion

A sufficient number of individual installations have been described to indicate quite clearly that the lighting system should blend with the general scheme of decoration. The illuminating equipment, rather than being dazzling, glaring or commonplace, is inconspicuous, and forms a part of the furnishing of the room.

It must be borne in mind that the methods outlined above are not the only correct schemes of lighting to use; often in the laying out of an installation the ideas or desires of the proprietor will produce considerable deviation from the scheme which would be most in keeping with the period of architecture that is being followed.

From the descriptions given, it can be seen that one is able to apply the commercial diffusers and reflecting devices to almost any class of service. As far as possible the endeavor has been made to discuss stores which had standard equipment, thus showing that there is no necessity for the design of special auxiliaries. Expanding this idea slightly, the authors believe that the stores described are distinctive and yet, with the exception of the carved alabaster bowls, the initial cost is relatively low.

These illustrations might have been continued at great length and an appropriate use found for almost all the equipment listed, but this is obviously out of the question, so the paper can well be closed with the admonition. In designing the lighting for shops of the class treated in this paper, use discretion in the selection of lighting units and do not offer the prospective customer something which is, on the face of it, purely utilitarian.

High Voltage Transmission Systems

A Review of their Electrical and Mechanical Design with Special Reference to the Equipment of the Shawinigan Water and Power Company (Con)

By Mr. Julian C. Smith

This high frequency oscillation striking the end turns of a transformer does two things, it creates a high voltage between the turns forming the end of the transformer, and at the same time, by suddenly changing the conditions which may be called the static conditions existing in the transformers, it changes the potential existing between the different sections of the transformer winding.

These sections act to some extent like the plates of a condenser, and when there is a sufficiently large difference of potential between them, a discharge is apt to occur through the oil from one section to the next and the transformer fails.

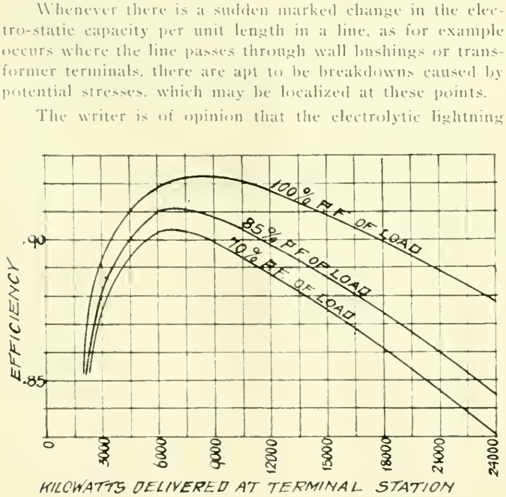
Thus one has an explanation of the breakdown of transformers on the interior of the winding, which is due perhaps to a disturbance striking the transformer from without.

These voltages between sections of a transformer are very high. For example, in a single phase transformer of 4,000 kilowatts capacity, built for 60,000 volts, there may be about 3,000 volts normal potential between the sections of the high tension winding.

To break down the insulation in this transformer at normal frequency requires about 60,000 volts, and yet many transformers have broken down under these conditions, showing that the strength of the insulation required at this particular point in a transformer subject to such oscillation, must be more than twenty times that required at the normal voltage.

Whenever there is a sudden marked change in the electro-static capacity per unit length in a line, as for example occurs where the line passes through wall bushings or transformer terminals, there are apt to be breakdowns caused by potential stresses, which may be localized at these points.

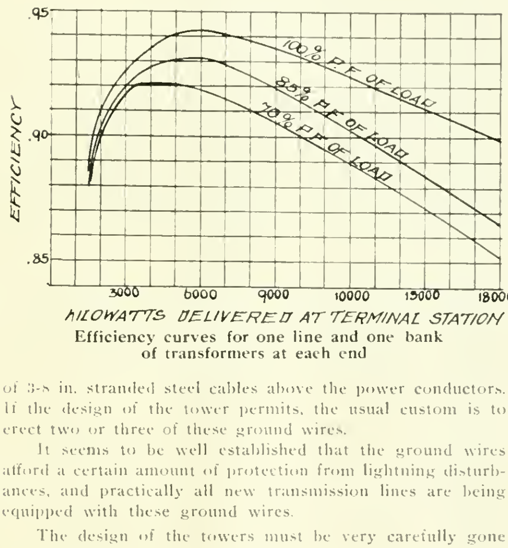
The writer is of opinion that the electrolytic lightning arresters have not proved to be a cure for all lightning disturbances. Outside of the facts mentioned above, on account of which the arrester may prove to be a menace to certain apparatus on the line, it seems that the arrester is not capable of discharging the heaviest oscillations which occur in practice on long transmission lines. This may be due to the fact that the arresters are not built today to take care of current rushes of more than a few hundred amperes, whereas, when the disturbances due to lightning are exceedingly heavy, the arrester may be called upon to discharge several thousand amperes. Thus in a big system, the writer believes that it is wise to provide some other means of relieving the voltage on the line.



Efficiency curves for one line and two banks of transformers at each end

The electrolytic arrester seems to have taken its place as the best lightning arrester which has been developed up to date, and doubtless further improvements will be made which will make the electrolyte and the film on these arresters of a more permanent nature and will eliminate the troubles which have already been experienced with them in service.

It is now common practice to erect ground wires usually of 3-8 in. stranded steel cables above the power conductors. If the design of the tower permits, the usual custom is to erect two or three of these ground wires.



Efficiency curves for one line and one bank of transformers at each end

It seems to be well established that the ground wires afford a certain amount of protection from lightning disturbances, and practically all new transmission lines are being equipped with these ground wires.

The design of the towers must be very carefully gone into and the sags of the steel wires and the conductors very carefully worked out, in order to prevent the ground wires coming in contact with the conductors under any conditions which arise during operation.

Various methods of working out the position of the wires at all points of their travel have been elaborated, and these methods must be applied for the different spans, and the location of the ground wire with relation to the other wires adjusted, so as to avoid trouble.

It is also customary to install section switches so that the line may be opened for testing purposes. The location and number of these switches depend so much upon the general character of the country through which the line passes, as well as the reliability of the line, that no general statement can be made. As any break of the continuity of the transmission line is to be avoided if possible, the number of sectionalizing switches should be kept a minimum.

On such a system as the Shawinigan, which consists of anchor towers located about one per mile, an easy method of opening up the line is provided

MECHANICAL DESIGN

The general mechanical design of the transmission line can be divided into four parts, the conductors, the insulators, the supporting structure and the foundations.

Conductors

The two principal materials used for conductors for long distance transmission lines (at the present time) are copper and aluminium. In some cases iron is used where a small amount of power is to be transmitted for a considerable distance, and where the economic size of copper would be too small to be safe mechanically. Copper clad wire is also in use to a considerable extent for special crossings where it is desired to obtain a great strength.

In the designing of transmission lines, the following figures may be considered to be present practice.

Material	Ultimate Strength	Elastic Limit	Modulus of Elasticity	Coefficient of Expansion
Copper (hard drawn)	60,000	30,000	12-16,000,000	.0000096
Aluminium	28,000	14,000	9,000,000	.0000128

Only the purest copper or aluminium can be used, as very slight impurities greatly affect the conductivity.

Insulators

Two widely different types of insulators are in common use; the pin type being used for voltages up to 60,000 volts, and the suspension type for voltages from 60,000 to about 140,000 volts.

The characteristics of these two insulators are quite different. Investigations on the phenomena taking place at times that insulators flash over, and to determine the reason why certain types are better than others, have indicated that the electrostatic capacity of one part of the insulators to another part has a very important bearing on the efficiency of the insulators.

The distribution of the potential from the conductor to the ground, that is to the point of support of the insulator, is not uniform, the potential gradient being very much steeper close to the wire, and becoming more uniform as the ground is approached. Thus that portion of the insulator which is close to the conductor has to stand a greater dielectric stress.

For low voltage, that is below 60,000 volts, pin type insulators can be constructed which give reasonahly good performance.

These insulators, under stresses due to lightning or other high potential and high frequency disturbances, fail often by puncture, showing that the material does not have sufficient dielectric strength to withstand the potential stress.

On suspension type insulators it is customary to use about six or seven units for 100,000 volts, and ten units for 130,000 volts, each unit having a flash over of about 55,000 volts. The following table gives the breakdown voltages of different numbers of a standard make of insulator.

No. of Units	Breakdown dry	Breakdown wet
No. 1	85,000	57,000
No. 2	164,000	108,000
No. 3	231,000	156,000
No. 4	260,000	210,000

From the theory which has been elaborated on insulator performance, it would seem that when it becomes necessary to obtain insulators for voltages above present practice, that is about 150,000 volts, such insulators must take the form of suspension type insulators, and the string of units will not be uniform. The insulators nearest the conductor will be designed with larger capacity than those nearest the ground so as to make the potential gradient as nearly uniform as possible.

In general, it is desirable that the insulators be so designed that they will not puncture under any conditions, but will arc over, either directly through the air, or across the surface of the porcelain, before the puncture takes place.

The materials of which the insulators are constructed will doubtless be improved, and we hope to obtain insulators having proper electrical characteristics, which will stand the arc of flashover without being destroyed.

Supporting Structures

The two main types of supporting structures may be said to be wood poles and steel towers. There are also some lines built of wood towers, and few other lines built of reinforced concrete poles.

Owing to the weight and cost of the towers, the design of these structures has been brought to a very efficient point, and the designers of the manufacturing companies in Canada and the United States are able to make their calculations so that each member of the tower performs its functions and the whole tower carries the load for which it is designed without any waste material.

It is customary to specify towers which will have certain spacing of conductors and which will stand certain loads. The following is the specification for the suspension towers of the Shawinigan line, as regards loading:

15,000 lbs. along or across the line, applied at the intersections of the upper cross arm with the tower axis.

3,000 lbs. at any two of supports for insulators for ground wires, a total of 6,000 lbs.

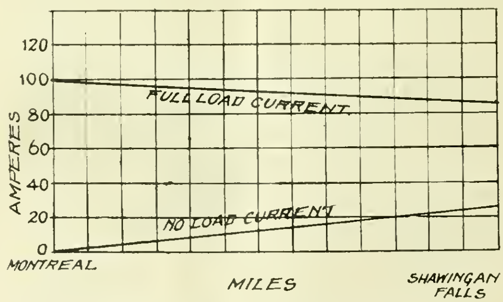
1,300 lbs. applied vertically at each of three insulators or ground wires—total 3,900 lbs.

1,300 lbs. applied vertically at all supports--total 10,400 lbs.

These towers are usually tested at the works of the maker, and it is interesting to note that the design has been perfected to such a point that the towers can be designed for exactly the predetermined load.

In making a specification for a tower such as that given above, the factor of safety is included in the loading, that is, the tower is designed so that if the loading should be more than that for which it is specified, the tower will fail.

The weights of the towers increase rapidly with the span.



Charging current curves, transmission lines 5 and 6

The table shows how the weights increase with increasing span with standard loading.

Span 300 ft.	4,100 lbs.
Span 400 ft.	4,350 lbs.
Span 500 ft.	4,700 lbs.
Span 600 ft.	5,400 lbs.
Span 700 ft.	6,400 lbs.
Span 800 ft.	7,500 lbs.

These figures are based upon a constant tension in the wires, that is to say the sag is increased by increasing the height of the tower, so as to maintain a constant tension as the span is increased.

The usual conditions, however, make the maximum stresses come when the wind is at right angles to the line and

the wires are covered with sleet. This load evidently increases as the span.

The table below is based upon a constant tension in the wires, and the increased weight of the tower is assumed to only take care of the increased height necessary to provide the tension sag.

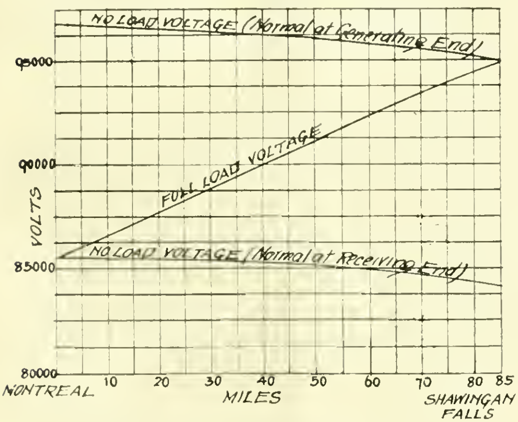
This is fairly true for such a small difference ot span as that indicated, but in general, as stated above, the weight of the tower increases much faster than the table indicates.

Although there is no formula in the writer's opinion which shows the variation of the weight of the tower with the increasing span, still it is easy to make calculations for each case, and a table can readily be prepared, showing the weight of towers properly designed to take the stresses to which they will be subjected, and then a computation can be made to indicate the minimum weight of the steel required for the whole transmission line.

*Span in feet	450	520	550	600
Cost of Tower	$163	$188	$201	$238
Cost of Installation	42	42	42	42
Cost of Foundation	70	70	70	70
Totals	$275	$300	$313	$350
Cost per foot	.61	.576	.571	.582

*1910 Prices.

The cost of the towers is usually on a pound basis, and



Voltage curves, transmission lines 5 and 6

this steel costs today a little more than standard structural material.

There are various designs for transmission towers including what are know as the suspension tower, the anchor tower, and the flexible tower, but the difference in weight and cost is not extremely great, and unless the cost of steel of which the tower is constructed is excessive, due to difficulties of transportation, the choice of the type of tower is largely one of opinion.

The weights of the hydro-electric towers and the Shawinigan towers are very nearly the same, although the general design of the towers is quite different.

Foundations

There are two main types of foundations for steel towers. One of these consists of an angle 6 in. x 6 in. bolted to each corner of the tower, and extending into the ground about 6 ft. On the bottom of this angle is placed a grill of bars or angles. The steel which is placed underground is usually coated with some special type of paint to prevent rusting or chemical action.

This type of foundation depends altogether upon the resistance of the earth which is filled in to the hole, the theory being that a cone having an angle of about 30 deg. can be assumed as representing the weight resting upon the grill.

The second type of foundation consists of a concrete pier, either plain or reinforced, containing a heavy foundation bolt to which each corner of the tower is attached. These concrete blocks are built in place by excavating the earth 6 ft. below the natural surface and bringing the tops of the piers to the proper grade. The piers are battered, and to a considerable extent the resistance of the earth is depended upon to hold the pier in place.

In very bad ground the steel angle footing has not proved successful, as the softening up of the earth above decreases the weight of the supporting earth and under high winds the footings are apt to be pulled out, and the tower tilted over. In good ground no difficulty is experienced with this type of footing, the only question being as to the life of the footing.

Sufficient experience has not yet been had in regard to the life of either the footings or the towers, to determine which is the proper design. In general, however, it may be stated, that the steel footings cost considerably less than the concrete.

There is a considerable advantage in the use of concrete footing during erection, as it is very difficult to put in proper template and grade, and keep the steel angle studs in place.

Owing to the uncertainty as to the action of the steel footings, both in regard to their life and their stability to withstand upward pressure under certain conditions of the soil above, the writer is strongly in favor of the use of concrete footings.

The following may be taken as the cost of a transmission line with conductors 250,000 c.m., and insulated for 100,000 volts.

Cost	Conductors	Insulators	Ground Wire	Towers	Foundations	otal
Per h.p.	$6.40	$2.50	$0.60	$8.90	$2.60	$210.00
Per Tower	248.00	97.00	24.00	347.00	102.00	818.00

Cost of Transmission Line, 100,000 Volts

Length of Line, 86 Miles—Number of Towers, 867—Average Span, 520 Feet

	Per Cent.
General survey	8.80
Excavation bases	2.16
Bases complete	6.1
Towers	24.0
Assembly of towers	2.95
Erection of towers	1.0
Insulators	7.9
Aluminium conductors, erected	19.6
Steel cable, erected	1.96
Telephone line complete	3.08
General office, engineering expense, tests, and inspection	2.46
Construction, plant, tools	2.86
Transportation of line material and tools	3.46
Camp equipment, supply transportation, etc., sheds, stores, office	8.32
Special construction, river, railway crossings, disconnecting switches	1.32
Freight	3.68

In the above figures are included taxes, interest, and insurance, equals 3.4 per cent. of the total.

The right-of-way where purchased in fee simple varies in cost from $25.00 per acre for barren or worthless lands to $250 per acre for well-cultivated farm lands, and to $2,000 or $3,000 per acre for lands near a large city. The total cost of the right-of- way is a large item and may be as high as 25 per cent. to 40 per cent. of the total cost of the construction.

If it is necessary to expropriate these lands the cost may greatly exceed the figures given above

Loading

For Eastern Canada and the North Eastern part of the United States, the loading to be used for the design of the towers is fairly well standardized, and is as follows:

Maximum wind stress 25 lbs. per square foot flat surface corresponding to a wind velocity of 80 miles per hour.

The conductors are assumed to be cylinders, and the wind loads on these are taken as half the load on the corresponding flat surface. Half of the area of the towers is assumed to be subject to the wind load.

The material is assumed to be stressed to the elastic limit under the loads taken, and these loads are supposed to be the worst possible conditions which can arise, that is to say, the factor of safety is taken into consideration in estimating the loads.

The ice or sleet load is assumed to be due to one-half inch around the conductor, and the weight of this sleet is taken as 55 pounds per cubic foot.

The temperature range varies with the location of the line, but it is customary to take for this, about minus 40 deg. F. as a minimum and plus 120 deg. F. as a maximum.

General Design

In laying out a new transmission line the designer should give careful attention to several features which decide the route.

1st. The accessibility of the line from existing railroads or highways.

2nd. The physical characteristics of the country.

It is very undesirable for a line to be carried over the crest of hills on account of the increased liability of trouble from lightning at these points.

Forests affect the cost of transmission lines. It is desirable to cut through a forest an opening 600 ft. wide to make room for two tower lines which would be spaced about 50 ft. apart in the centre of this opening. In high winds there is a very large amount of flying material in the air, and small branches of trees are very apt to be blown against the wires. There is also the more serious danger of forest fires which would destroy the transmission line completely, and render the repairs difficult and lengthy.

In laying out a new line it is important that accurate information and maps be obtained showing the exact profiles of the proposed route, and giving sufficient information so that the location of every tower can be predetermined and profiles drawn up to show the position of the conductors both at minimum and maximum sags, for every span throughout the line.

LEGAL OR PUBLIC ASPECTS OF THE PROBLEM

The status of transmission line enterprise at the present time is not as well defined in Canada and the United States as is desirable.

Some of the states such as Massachusetts and New York have enacted very stringent laws giving public utility commissions jurisdiction over all public utilities.

In Canada, the laws in the different provinces vary considerably, the province of Ontario having taken quite a different stand from the control of private corporations by commission. Instead of this the province of Ontario has developed on extensive state owned system,—and is administering this by selling power purchased from a private company to various public municipal corporations.

In addition, Ontario has given this commission very large powers of control over other public service corporations within the province.

In Canada transmission companies can be incorporated either by Federal or Provincial Statutes. Whatever rights the transmission companies may have, such as the right of eminent domain, are granted in their charters, and the result is that the different charters granted to different companies vary widely as to the rights given.

There seems to be a general tendency throughout Canada and the United States to decrease the powers granted to these companies, particularly when such powers interfere with municipal by-laws.

A new enactment almost always provides that special permission must be obtained from municipalities before poles and wires can be erected in the streets.

Owing to the danger which would exist to overhead systems in the event of failure in a high tension wire, it is a well established custom that high tension systems for the distribution of power throughout the district, using voltages of over 15,000 volts, should not be erected on the streets of any thickly populated city or town.

This is not to be understood as stating that it is not customary to bring high voltages into cities when these high voltages are used for a main line ending at a substation. Special care must be taken in the design of pole or tower lines carrying such high voltages in cities and (in general) long spans cannot be used on account of the swinging of the wires.

There is a large amount of missionary work to be done still in the education and instruction of the general public, with regard to transmission lines.

Largely through ignorance, a considerable amount of interference takes place constantly with these systems. Young men and boys who would not think of tampering with the operation of a railway system, do not hesitate to interfere with the delivery of power.. Such interference is almost always based upon ignorance, and in many cases results in injury to the person tampering with the line. As engineers, it is our duty to see that more information is made public, as to the serious effect on industry in general, of such interference with transmission lines, and to bring it to the attention of the authorities, such as teachers in the schools, and other instructors of the public, so that the facts regarding the importance of not interfering with the service on transmission lines, may be appreciated.

Another important matter is to emphasize the cost of these systems. There seems to be a general impression that a transmission system as such is a small part of the total development, and if power can be generated even at a high cost, that this power can be transmitted long distances and sold at a profit.

It need hardly be pointed out that the facts are quite opposite to this. The present cost of these lines when constructed as outlined in this paper varies from $40.00 per h.p. for a 100 mile line delivering 25,000 h.p. up to a very much higher amount for smaller propositions.

Thus it can be well understood that the transmission line may cost as much per horse-power, as the whole hydraulic development.

In figuring the cost of the delivered power, where the market is at a considerable distance from the source of power, it is therefore very necessary to realize that the cheap source of power does not in itself indicate that the proposition can compete economically with other power plants located closer to the source of the market, or with steam plants located right at the market.

Kerry & Chace, Limited, has been incorporated to carry on operations as consulting, constructing and operating engineers. Head office Toronto.

United States President Wilson is said to have in course of preparation plans for the acquisition of the telegraph and telephone systems of the United States, these to be operated as a government enterprise.

Telephones in Forestry Work

Within the past year remarkable advances have been made in forestry matters in British Columbia, the records returned to the forestry branch at Victoria indicating a distinct and permanent turn for the better. This applies in particular to the Coast district of the province where, under the direction of Mr. G. D. McKay, provincial timber inspector and chief fire warden, noteworthy advances have been made in providing methods whereby the news of an outbreak of fire can be acquired with the least possible delay. In addition to the construction of numerous trails, look-out stations and other facilities to ensure a minimum of delay in bringing assistance to any points where a bush fire may be observed, the work of the provincial branch is being further expedited by the establishment of a complete system of telephone communication, the reports of the various forestry experts in the earlier part of the present year urging the necessity for increasing the efficiency in this direction.

At the present time the only lines in use by the department are the B. C. Telephone system which is within easy reach of every fire warden in the Fraser Valley District, and the Dominion government telephone and telegraph line extending along the Coast from Vancouver to Lund, a distance of about 100 miles, and westward from the latter point to Campbell River on Vancouver Island by way of Heriot Bay on Valdez Island, an additional 40 miles. Communication with wardens stationed at points further north is effected by means of wireless to Alert Bay, where the ranger for that district makes his headquarters, a distance of about 222 miles from Vancouver.

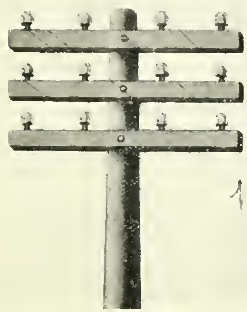
The telephone system which will be provided by the provincial government for the use of the forests branch consists of three distinct lines covering the operations of the fire fighting forces in the Coast district, with direct connection to headquarters at Vancouver and Victoria. One of these lines will follow the coast line on Vancouver Island from Campbell River to Alert Bay, a distance of 100 miles, with branch lines extending up the courses of the Salmon and Campbell Rivers for a considerable distance. After this route had been surveyed last spring by Mr. H. E. Elsden, telephone expert for the provincial government, it was learned that the Dominion authorities had already completed plans for the extension and as definite assurance has been forthcoming from Ottawa that the line will be built at an early date, the question of its construction has been left in the hands of the Dominion government.

The most important line to be constructed will extend from Heriot Bay on Valdez Island—where connection will be made with the Dominion government telephone system—to Shoal Bay on Thurlow Island, some 60 miles distant. This route was surveyed under the direction of Mr. Elsden last June, and it is expected that the construction of the line will be completed by November 1st. Extending through the largest logging district in the province, this line will provide communication with fully 100 settlers and upwards of 50 logging operators. Next year it is intended to push construction some thirty miles further to a point on Loughborough Inlet, a survey of this section being already completed. From Loughborough Inlet the route will eventually be extended by way of Roy Post office, Jackson Bay, to Glendale Cove near Tom Brown's Lake on Knight's Inlet, which will be its termination for the present. When completed this line will be about 150 miles in length, and will tap the logging operations of the Coast of the mainland from Heriot Bay north to Queen Charlotte Sound.

The third line contemplated will commence at Old Douglas on Harrison Lake, 65 miles east of Vancouver, connecting with the B. C. Telephone Company's system at that point, and extending along the route of the Pacific Great Eastern Railway to Pemberton Meadows, a distance of some 60 miles. This line will be erected at a very moderate cost, owing to the fact that for almost the entire distance it follows the old Cariboo wagon road, which is still in fair condition.

Railway Telephone Device

The value of the telephone in railway work for the handling of trains is now very generally recognized. In June, 1908, only a little over five years ago, the first train despatching circuit in Canada was installed by the Canadian Pacific Railway between Montreal and Farnham, a distance of 45 miles. Early in the present year telephone equipment on the main line of the British Columbia division was completed so that with the exception of one of the double track sections between Winnipeg and Fort William the trains on the whole main line of the C. P. R. from ocean to ocean and on



Telephone can be attached anywhere along the line

a large number of the branch lines are now operated by telephone on metallic circuits. In addition every railway of importance in Canada and the United States has at least part of its lines, where heavy traffic is handled, equipped with the telephone train despatching apparatus.

The telephone circuit also permits the use of emergency instruments on each train whereby at any time and at any place along the line, by bringing the train to a standstill, the conductor or any member of the crew may place himself in immediate communication with the dispatcher at head office. This device was invented by Mr. J. F. Richardson, superintendent of C. P. R. telegraphs for British Columbia and is shown ready for action in the accompanying reproduction. The device consists of a pair of hooks attached by means of a long pole to the two wires of the telephone circuit, these hooks being connected by two wires to the telephone instrument. The C. P. R. have over 2,000 trains equipped with this device and many other railways in Canada and the United States are installing them at the present time.

Have Increased Capacity

The Eugene F. Phillips Electrical Works, Limited, of Montreal, have added very largely to their capacity for making telephone cable by installing the entire equipment of the telephone cable department of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, New York. The plant was purchased by Eugene F. Phillips Electrical Works, Limited, and is now running in the extension to the Montreal company's works recently constructed at a cost of about $250,000. The company, who have been manufacturing telephone cable for many years, are now in a position to execute very extensive orders.

Electric Railways

New Twenty-two Mile Extension to the B. C. E. R. Lines on Vancouver Island, B. C.

Sir Richard McBride, Premier of British Columbia, recently "drove the last spike" of a new interurban extension of the electric railway system of the British Columbia Electric Railway Company, Limited, on Vancouver Island. The act was the final stroke in an undertaking which has been in progress for the past two years and on which over $1,000,000 has been expended.

The new extension of the B. C. Electric is located on the Saanich peninsula and was constructed with the idea of connecting the various districts of this section of the island with Victoria, the capital of the province. The line is about 22 miles in length and extends from Victoria almost directly north, passing through the centre of the Saanich district and terminating at Deep Bay situated at the northern end of the peninsula. On its course a short branch line has been constructed to Meadlands, a beautiful resort on Patricia Bay, a branch of the Saanich Gulf.

In planning the Saanich line the B. C. Electric looked somewhat into the future and secured several large tracts of land at eligible points which are being held for specific purposes. Near Patricia Bay the Meadlands estate was secured and at this point it is planned to create a modern suburban townsite of high standard, plans for the laying out of the place being now under consideration. The bay at this point is such as opens up great possibilities as a picnic and pleasure resort and developments along this line will also be undertaken. At the terminus of the line, Deep Bay, another beautiful pleasure resort is afforded and this point will be developed by the company as a model picnic ground.

Along the route of the line is also located the Dominion Agricultural Farm which was purchased a few years ago when the interurban line was planned. This tract has already been cleared and is partially under cultivation. Within a few years it will be brought to a high standard and conducted as an experimental farm where the resources of the district may be tested under trained supervision.

At Deep Bay facilities are provided for connection with the many fertile islands in the Gulf, all of which are now partially developed and devoted to agriculture. Promptly with the opening of the line regular launch service was inaugurated between Deep Bay and these islands and the produce from the points is now daily brought to Victoria over the new extension.

Industrial life is also to play a part in the development of the Saanich peninsula, as on it are located two large cement plants as well as numerous industries of lesser size. One of these cement plants, located at Bamberton Bay, was opened about the same time as the interurban line. The industrial possibilities along the extension may be judged when it is stated that this single plant involves an expenditure of $1,250,000, and that the daily output will be 2,000 barrels. Power for the operation of the plants is provided by the B. C. Electric.

All the above facts concerning the probable development of the Saanich peninsula and the advantages which residents of Victoria will derive from the line were pointed out at the banquet which was held in connection with the opening of the line. Premier McBride said that it was only a few years ago that he officiated at the opening of the 76-mile extension of the B. C. E. R. Co. through the South Fraser Valley, from Vancouver to Chilliwack. He expected that the Saanich line would do for Victoria and the Saanich peninsula all that the Fraser Valley line had in a few years done for Vancouver. Premier McBride also paid high tribute to the B. C. Electric for its work in developing the province, noting that the company had already invested over $40,000,000 in order to provide for the demands of the public for light and power and electric railways and was still planning large undertakings for the near future.

The company have anticipated the requirements of this new road and already have ample power in both hydro-electric and steam developments to take care of the increased demands. At Jordan River, where their main water power

Map showing B. C. E. R. Vancouver Island lines

is situated, 12,000 h.p. is available, with a second 12,000 installation almost completed. At Goldstream there is also the early development of 3,000 h.p. The steam plants consist of 1,500 h.p. capacity situated in Victoria City, and 6,000 h.p. recently installed at Brentwood Bay, a point on the west coast of the Saanich Peninsula, which is at about the middle point for the new railway line.

The hydro-electric plants and the Brentwood steam plant are all interconnected, so that a supply of power for the operation of the road is assured in any emergency. The accompanying map shows the location of the power plants. The map also shows, in a general way, the complete railway system in Victoria city and the Saanich peninsula. The new line is now being operated at 550-600 volts d.c., but arrangements are being made for its operation at 1200 volts d.c.

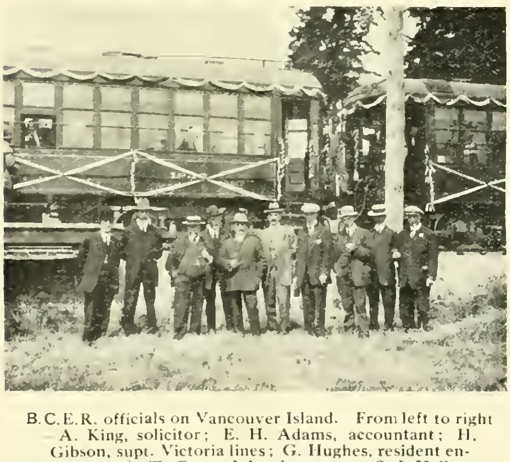
The passenger cars provided for the line are 50 feet over all and are equipped with four 75 h.p. motors. Provision

is made for train operation, all cars being provided with type M multiple unit control. In addition to a full complement of passenger cars the line is provided with baggage and express cars and locomotives and box and flats for freight traffic.

Twenty-two stopping points are now provided along the

B.C.E.R. Steam plant, Brentwood Bay

line at each of which a neat shelter has been erected. The regular schedule from Victoria to Deep Bay calls for operation in 1 hour and 15 minutes. Three car trains are used for the run, the schedule calling for trains in each direction every three hours from 6.40 a.m. until about 11 p.m. The location of stations and running schedule are at present



B.C.E.R. officials on Vancouver Island. From left to right A. King, solicitor; E. H. Adams, accountant; H. Gibson, supt. Victoria lines; G. Hughes, resident engineer; A. T. Goward, local manager; S. J. Halls, supt. light and power; F. D. Picken, supt. Saanich line; G. M. Tripp, engineering supt.; A. Richardson, stores accountant; F. M. Hewlings, supt. gas company.

only temporary and will probably be altered to suit traffic conditions which may develop. The passenger traffic over the line is based on a maximum of three cents per mile.

In connection with the opening of the Saanich line the B. C. Electric issued a souvenir which noted the growth of the company's investment and business on Vancouver Island as follows:

	1890	1903	1913
Capital expenditure		\$900,000	\$7,000,000
Miles of track	8	12	60⅝
Number of cars	4	16	55
Horse power utilized	350	2700	23,000
Horse power under present development			13,000
Number of employees	50	120	820
Office staff	2	15	102
Miles of lighting circuit		65	150
Miles of gas mains		10¼	45

Regular traffic on the Saanich line was started the day after the official opening and results equal to the expectation of the management have already developed.

The line was constructed under the direction of general manager R. H. Sperling, assisted by chief engineer G. R. G. Conway. In the supervision of the work the general management of the company had the hearty co-operation of its Victoria staff which includes local manager A. T. Goward, general superintendent G. M. Tripp, resident engineer G. Hughes and F. D. Picken, who will be superintendent of the branch.

M. & S. C. Extensions

The Montreal and Southern Counties Railway Company are pushing ahead with their extensions, and have let the contract for building the concrete substructure of a large bridge—four piers and two abutments—to be erected over the Yamaska River at St. Cesaire, P.Q., to Messrs. Ross & McComb. The same firm are constructing the line through the town of Granby, P.Q., a distance of 6,300 feet. The extension from Richelieu to Marieville was opened on Saturday, September 27, with a certain amount of ceremony, and the company are now engaged in building the extension from Marieville to St. Cesaire, and hope to have it completed by the end of the year. Operations have been commenced on a concrete sub-station at Rougemont, and this will be equipped with a 300 kw. motor generator set, one bank of transformers, high and low tension switchboards, lightning arresters and switching apparatus. About 12 new cars are to be purchased. These will be 57 feet long, as against 50 feet for the present cars, and are designed to have through platforms. They will be of the multiple unit single control type. Toilet accommodation will be provided. Baggage cars are also to be purchased

New Type Trailer

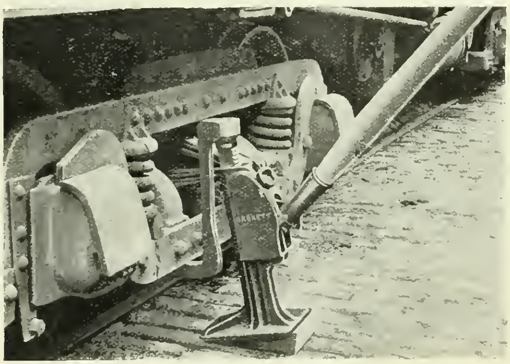
Major J. E. Hutchison, general manager of the Montreal Tramways Company, has designed a special type of trailer car which is to be used on the St. Catherine Street service. Twenty-five trailers are under construction, and Montreal will thus add a new feature to her transportation facilities. The idea of utilizing old cars has been rejected, and Major Hutchison has planned a car which he believes will overcome the objections to the usual form of trailer. The new type will couple up close to the motor car, an automatic coupler and three-way connector being provided for breaking, lighting, heating, and automatic door signal. A special appliance will close the doors and fold in the steps of the trailer before it will be possible for the cars to start. The leading car will have a seating capacity of 44, and the trailer will accommodate an additional 54 passengers. The entrance to the cars will be at the rear of the motor vehicle and the front of the trailer. The exits will be at the front of the motor car and immediately behind the entrance in the front end of the trailer. There will be neither entrance nor exit at the rear of the trailer. This design will make it possible for one conductor to operate both motor and trailer cars.

An Emergency Car Jack

The accompanying illustrations have reference to an emergency car jack being manufactured by the Duff Manufacturing Company of Pittsburgh. Fig. 2 shows the jack in operation, replacing a derailed car on the track. This emergency car jack is often referred to in the United States

Emergency car jack

as the "Bay State" jack, as all the street railway systems in Massachusetts have been equipped with it, every car carrying a jack for use in case of derailment. Among other street railway systems that have adopted this equipment for every car in operation on their line may be mentioned the Harris-



Showing jack in operation

burg, Pa.; all interurban cars in Pittsburgh; all cars of the Scioto Valley Traction Company, Columbus, Ohio, and the wrecking cars on the electric railways in New York city, Pittsburgh and many other cities.

Calgary Municipal Annual Report

Mr. T. H. McCauley, superintendent of Calgary's municipal railway system has just issued his annual report for the year ending June 30th, 1913. During that time the gross revenue from operation amounted to \$704,053, of which 71.31 per cent. was eaten up in operating expenses. The gross earnings per car mile figured out at 26.585 cents and the operating expenses at 18.96 cents. The average fare, revenue passengers only, works out at 4.008 cents, but including all passengers and transfers was 3.022 cents. The total mileage, single track, now amounts to 71 miles. The rolling stock consists of 70 motor cars, 6 trailers and 12 miscellaneous; 8 cars, 46 ft. type, are now on order. The cost of construction and equipment per mile of road owned is placed at \$28,210.

Street Railway Extensions in St. John

It is expected that within two months the St. John, N.B., Railway Company will have its line extended for a mile along the Marsh Road and thence to Kane's Corner and in again, making a circuit and giving a service which will be of great benefit in building up the section traversed by the line. The city council and the company have come to terms, and the work of construction will be proceeded with immediately, as the company have a supply of rails and ties sufficiently large to complete this important extension of their line.

Sherbrooke Railway and Power

During the financial year which ended on June 30th last the gross earnings of the Sherbrooke Railway and Power Company increased \$34,058, and the net \$14,978, and after payment of all charges the sum of \$3,216 is carried forward to the credit of profit and loss. Two large concerns, during the summer, entered into contracts to take power, and these are estimated to bring in an annual revenue of \$21,500. The company's lighting system has been extended to four villages, while there has been an increase in the lighting and power business at Lennoxville, Stanstead, Beebe Plains, Derby Line and Derby Centre. The increase in net revenue last year was principally due to the lighting and power branches of the company's system.

Miscellaneous

A vote will be taken during October on the question of spending \$700,000 on the electrification of the London & Port Stanley Railway.

Application is being made to the Ontario legislature for the incorporation of the London, Grand Bend and Stratford Railway Company.

The fourth annual convention of the Electric Vehicle Association will be held at Hotel La Salle, Chicago, on October 27 and 28. A program of special value to all interested in electric vehicles will be presented.

Mr. J. L. Englehart, chairman of the T. & N. O. Railway commission, is credited with the statement that the Kerr Lake branch of that railway may be electrified next year, in which case it would be operated as a section of the present Nipissing Ceneral system.

A certain German street car line operating between cities in Rhenish, Prussia, charges only about half the regular passenger rates to those who stand. The fare from Elberfeld to Werden, a distance of about 10 miles, is 30 cents for those having seats and 17 cents for those standing. The round trip rate costs 50 cents if the passenger has a seat, while those who remain standing pay only 25 cents. The trip from Elberfeld to Werden takes 1 hour and 50 minutes.

A deputation of members of the Ottawa City Council recently waited on Mr. Thomas Ahearn, president of the Ottawa Electric Railway Company, to ask for the extension of the workmen's tickets, which now sell at eight for 25 cents and may be used from 6 to 7.30 o'clock in the morning and from 5 to 6.30 in the evening. The deputation requested that the time for the tickets be extended until eight o'clock in the morning and made good from 12 to 1 o'clock at noon time. Mr. Ahearn replied to the deputation that the company would be unable to grant the request as there is no profit being made on this class of tickets at present.

The Dealer and Contractor

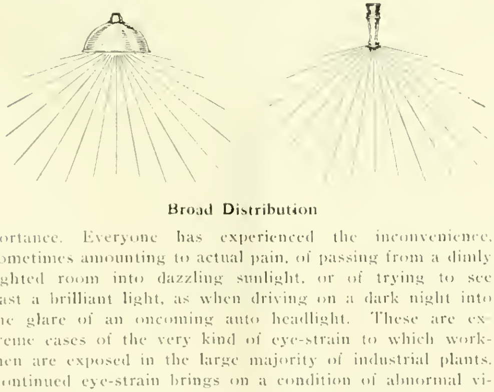
Lighting of Mills and Factories

(Contributed)

No factory executive will deny that good artificial illumination is necessary to the efficient operation of an industrial plant. The mass of convincing evidence to this effect which has been collected by production and efficiency engineers, by cost analyses and even by those practical factory managers who cling to the rule-of-thumb, leaves no defense for inadequate lighting. Good illumination is cheap; poor illumination is not only expensive, it is wasteful and inexcusably extravagant.

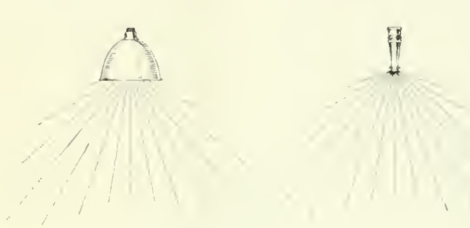
The essential problems in the lighting of mills and factories are three: first, to provide sufficient illumination and at the same time to protect the eyes of operatives; second, to provide for efficient distribution of light both by proper placement of units and by selection of units according to their reflecting characteristics; third, to arrive at an evaluation of all factors of cost and value so that a true cost comparison may be made as between different types of equipment.

The protection of the eyes of operatives is of first importance. Everyone has experienced the inconvenience, sometimes amounting to actual pain, of passing from a dimly lighted room into dazzling sunlight, or of trying to see past a brilliant light, as when driving on a dark night into the glare of an oncoming auto headlight. These are extreme cases of the very kind of eye-strain to which workmen are exposed in the large majority of industrial plants. Continued eye-strain brings on a condition of abnormal vision. This condition usually does not cause an immediate permanent injury to the eyesight, but it is during the temporary period of abnormal vision that spoilage, errors, and accidents are most likely to occur. Proper eye protection requires a system of lighting which eliminates brilliant points of light within the range of ordinary vision, and one that avoids violent contrasts of light and shadow. This is best accomplished by the use of mazda lamps equipped with extensive or intensive deep bowl reflectors. These reflectors have been designed so that they are of sufficient depth to cut off direct glare, and so that they give distribution of light such that they may be spaced to provide an illumination of high intensity, and excellent uniformity when hung well above the range of ordinary vision.



Broad Distribution

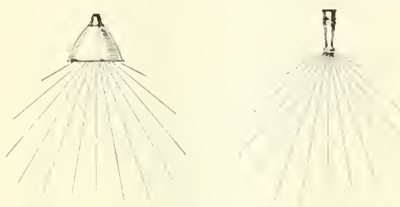
The shallow dome, and shallow bowl distributing shapes which give a broad distribution of light are recommended only for the lighting of warehouses and similar spaces where the question of eye protection is of little importance. The effect of the shallow reflector on the workmen's eyes, as compared to the deep bowl is illustrated in the accompanying diagrams. It is a common error to select shallow shaped reflectors giving the broad distributing distribution on the supposition that they will give a uniform illumination when spaced at greater distances apart than the extensive and intensive bowls. Distributing reflectors throw some light to a greater distance than extensive reectors but not in sufficient quantity to provide uniform illumination when spaced at greater distances apart.



Extensive Distribution

With the question of eye protection settled, the selection of reflectors should be made because of the distribution of light which they will deliver and not because they are flat, shallow bowl or dome-shaped.

At first glance it may appear to the factory executive that a discussion of light distribution is a highly technical subject, but it is not at all difficult when one compares the reflector with an adjustable hose nozzle. The diagrams reproduced herewith show that just as the nozzle can be adjusted to throw the water in a stream varying from a fine spray which covers a broad area with a small amount of water per square foot, so can the reflector, when properly designed, control the light, distributing it widely at comparatively low intensity or focussing it into a concentrated stream of great brilliance.



Intensive Distribution

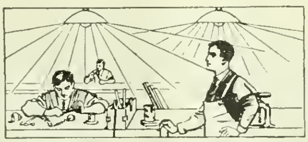
It is commonly understood that the distribution of light given by a reflector depends upon the reflector's shape. While this is true in a limited sense, it is also true that two reflectors of widely different shapes may give almost identical light distribution. For example, the shallow dome dis-

tributing type reflector and the shallow bowl distributing type reflector give exactly the same distribution of light although the two shapes are widely different. The reason for the difference in shape is found in the remarkable dissimilarity in the reflecting characteristics of "cleanezy" aluminium and porcelain enamel with which the two shapes are finished. From this it must be obvious that the distribution and

Deep bowl reflector protects the eyes.

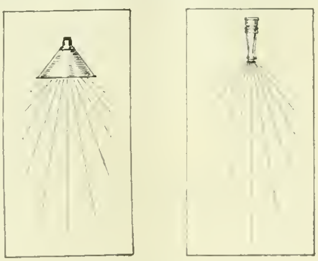
not the shape is the first consideration in the purchase of reflectors, and that of two reflectors having approximately the same distribution curves, that one is the more desirable which more nearly meets the other requirements of the installation.

And this is true practically without regard to the cost of either reflector. The question of cost of lighting equipment is one which is too often decided from the standpoint of the purchasing agent rather than the broad vision of the operating executive. A proper lighting unit is just as necessary to the efficient, continuous operation of a machine as is proper lubrication. No factory manager would employ unsuitable lubricating oil for the sake of a slight economy, yet we



Not suited for close eye work.

frequently find unsuitable reflectors selected solely upon a price argument. A skilled operative may be paid from 25 to 60 cents an hour, and in this latitude works probably not less than 300 hours by artificial light, his wages amounting to \$75 to \$180 per year. Weigh either sum against the cost of the lighting equipment which may either facilitate or retard that workman's labor, and the relative insignificance of the reflector cost is apparent. Or consider it against the value of the work performed. In operations where the pro-



Focusing distribution.

duct is nearing completion, a very slight error may destroy the result of many hours of labor. Under such conditions, any reasonable price which may be invested in lighting equipment which will eliminate eye-strain and at the same time provide ample illumination may properly be considered as insurance upon work in process.

A summary of these remarks will show:—

(a) That avoidance of eye-strain and provision of ample illumination are of equal importance in the lighting installation:

(b) That in selecting a reflector for a given service, distribution of light and eye-protection are primary, and the shape is secondary; and,

(c) That the price per reflector is negligible as compared with the value of the permanent service it renders, and should be disregarded except in comparing reflectors which are equally desirable in other respects.

The Fallacy of the One-Light Unit—The Customer's View Point

(Contributed)

Better distribution of light by means of a one-light ceiling unit carries no weight as an argument, for the additional expense of the multi-circuit wiring more than offsets any apparent benefit. Efficient light distribution from an arm type fixture is merely a matter of selecting the scientific reflector best suited to the requirements.

Grouped lights on a fixture certainly tend toward economical operation when the pendant switch is used, permitting of the control of any of the lights on the unit. With the switch made accessible this economy proves a fact. Here is economy in operation to which must be added the saving not only in wiring, but also in fixture installation. The use of the large size, one-light lighting units must in practice call for increase maintenance cost, and at the same time prove troublesome in the case of a burn-out, which leaves a large area without illumination. Distributing the candle power developed over a number of smaller lamps safeguards against these conditions and permits of working lamps up to their full efficiency without the extreme high cost for replacement prevailing in the large type lamps. Original installations of the 250 and 500 watt lamps are frequently changed to smaller size without any change being made in reflectors, holders, etc., thus robbing the entire installation of any suggestion of efficiency or science. There is an abundance of this evidence against the larger types in everyday practice. It is generally acknowledged today that the lighting fixtures are usually the center of the decorative scheme in a room's appointments. How much greater freedom the artist finds in designing a multi-light unit, but how restricted are his efforts in the case of the one-light types.

Every installation of fixtures made that represents better ideals in lighting is an advertising asset of lasting value to the dealer and contractor, as well as to the central station and the community. Every installation that does not, is a set-back in revenue and a reflection upon the splendid possibilities of the tungsten lamp and those who improperly install them.

Five convincing reasons can be advanced for hanging group fixtures high:—

First—The source of light is removed from the direct range of vision.

Second—A better distribution is obtained within the candle power limits of the lamp.

Third—The space to be lighted presents a roomier appearance by reason of the fixtures being higher up.

Fourth—The danger of the lamp and reflector being struck by a person passing beneath them is eliminated.

Fifth—None of the light from the lamp is wasted by being absorbed at the floor.

Your customer may object or flatly refuse to consider your suggestion. Here is where your opportunity comes in for exercising your talents and knowledge gained from a close study of the business, for, by a logical presentation of the facts your customer is bound to see the advantage of a proper installation, even though this approval may not come until the work is done. In this you are building for yourself and your own reputation for satisfactory work.

Series Mazda Street Lighting

The use of mazda lamps for street lighting in residential districts is recognized as being particularly desirable since with any lighting source the intensity of illumination

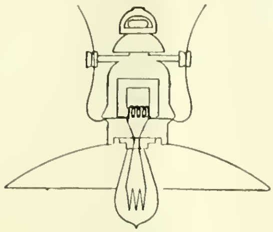


Fig. 1

is proportional to the square of the distance from the lighting source. Hence if the distance between the lamps is greater, for example twice as great, the lamps must have four times the candle power and consequently a mile of street will require twice as much energy. This is all the more necessary on streets where there are trees, as in this case are lights, which of necessity have to be placed high up, lose much of their value.

For mazda street lighting the lamps are preferably operated in series, the same current passing from the source through all the lamps and back to the source. In the ma-

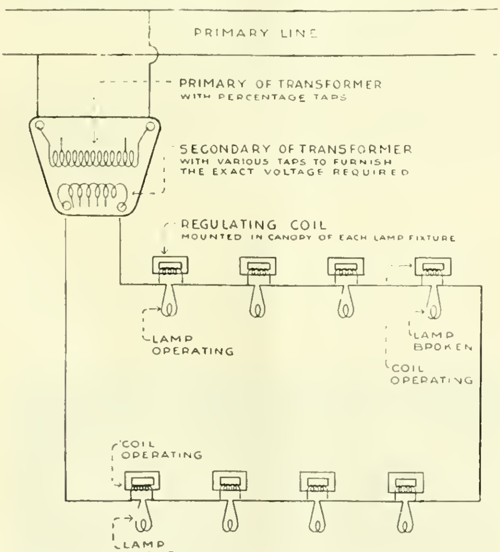


Fig. 2

jority of systems constant current regulators are provided in the generating station which further require panel-boards and auxiliary apparatus. In addition to the cost of equipment being considerably more, station space has to be provided and an attendant is required to watch the regulator. The efficiency and power factor of such a system is also low, figures for quarter-load showing often not greater than 23 per cent.

The Pittsburgh Transformer Company have devised a new scheme which does away with the more complicated apparatus. Around each lamp a regulating coil is connected. This coil has a reactance practically equivalent to the resistance of the lamp film so that when the lamp is "out" the coil automatically takes it place. The cutting in or out of the coil is of inductive action and is therefore accomplished without any moving parts. The equipment of the lamp unit is shown in diagram in Fig. and Fig. 2 represents the plan of operation of a small system.

To supply the voltage necessary for lamps operating in series a simple constant potential transformer is furnished, connected to the primary lines, and the secondary winding is designed for a wide range of voltage. This voltage arrangement allows lamps to be added to or taken from the system and is capable of adjustment through about thirty per cent.

The regulation of this system can be considered as being practically perfect. Constant current is provided under all normal conditions and lamps up to 30 per cent. may be out without appreciably affecting the regulation. With a greater number of outages than 30 per cent. the only effect is a gradual reduction in the current strength which constitutes a very necessary protection in case of accident.

A New Lamp Design

The arrangement of the filament in ordinary metal wire lamps is very unfavorable from the point of view of illumination distribution as is very clearly demonstrated in the

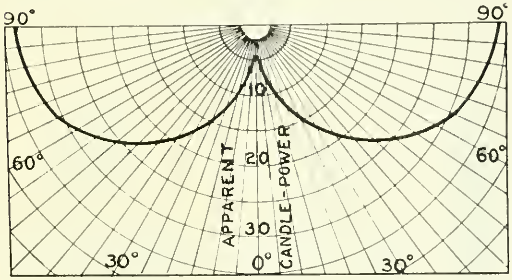


Fig. 1

light radiation curve in Fig. 1. A 32 candle power metal wire lamp of the usual shape only radiates 5.1 standard candle power downwards (in the direction of the lamp axis), the bulk of the light being given laterally. As many chandeliers and other illuminating agents burn with the tip hang-

Fig. 2

ing downwards, this irregularity in the distribution of light naturally makes itself unpleasantly felt. It is true that this can be, to a great extent remedied by the use of suitable reflectors, but it must be remembered that losses in the illuminating power occur at every reflection, and that the adop-

tion of reflectors is vetoed by many illuminating agents on aesthetic grounds.

Though the manufacture of metal wire lamps has reached a high state of perfection, there is no reason to retain the forms hitherto in general use, and the Philips Metal Gluhlampenfabrik A.G., Eindhoven (Holland), have taken up the construction of a new type of lamp, "the Projector," in which the filaments are so arranged that the strength of light is almost uniform in all directions. The filaments of the projector lamp do not run parallel on the filament support, but lie stretched in a conical surface. Figs. 2 and 3 show a 32-candle power projector lamp and its light radiation curve. A comparison with Fig. 1 will show at once that this is a very actual improvement; the effective illumination is many times greater than that on an ordinary metal wire lamp, and the strength of light remains the same whether the lamp burns in a vertical, horizontal or inclined position.

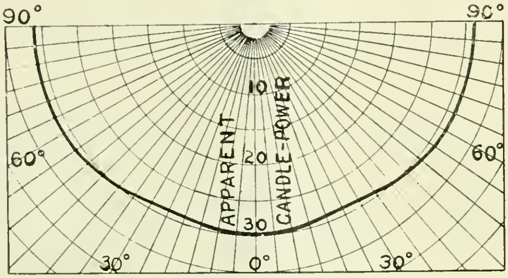
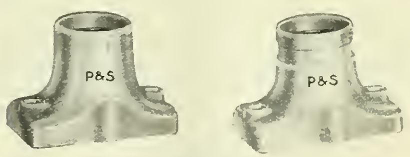


Fig. 3

P. & S. Receptacles

The accompanying illustrations represent the two receptacles of Pass & Seymour, Inc., primarily intended for use on wood moulding but which have been changed so that they may also be used on pipe taplets.



Good Advertising

The Toronto Hydro-electric System have made a specialty of window advertising which is doing much to educate the passer-by regarding the uses of electric light and power. During the last week of September one of their windows has been given over to a demonstration of the relative merits of different systems of controlling the lighting source, the idea being to show that it is not so much the quantity of light used as the proper distribution of the light which makes for good illumination.

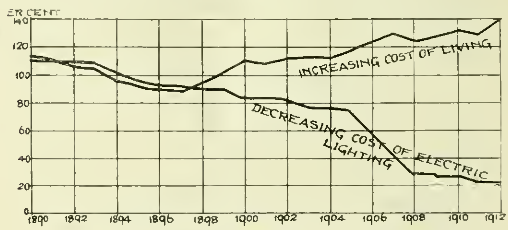
The entire window, measuring 21 ft. x 10 ft., was turned into a demonstrating laboratory, the window was curtained up the front, over the top and down the back to the height of some 2 or 3 ft. above the ordinary observer on the street; the ends were also carefully curtained off. In this way no light entered the window from outside except through a number of small peep holes arranged at various heights to accommodate the different observers.

The enclosure was divided at the back into six booths or stalls about 30 inches square. These six booths were grouped in pairs, so as to show three comparative tests. The lamps used throughout were Sunbeam mazda 60 watt clear globe, 115 volt type. No. 1 showed comparative results with one lamp enclosed in a number 7507 Holophane Realite and one lamp enclosed in a 6-inch roughed inside cut star ball—very much in favor of the former. Test number 2 compared seven bare 60 watt clear lamps bunched together with one small lamp mounted with a 8300 Holophane reflector. Even in this extreme case the illumination of cards placed on the floor under the lamps was considerably greater in the case of the single unit. Of course, the general illumination was better with the 7 units.

Test number 3 was a comparison between the ordinary white glass reflector and a Holophane scientific prismatic reflector both manufactured and recommended for 60 watt lamps.

Small cards called attention to each test and to the value of a correct system of illumination. One of the cards emphasized the aim of the demonstration with the words "It is not the amount of current you consume but the results you obtain from its use that interests the Hydro." The various types of globes and reflectors used in the demonstration were kindly supplied for the occasion by The Holophane Company.

During the same week the north window of the store was decorated with a huge chart some 20 ft. in length and 6 or 7 ft. high, demonstrating by two relative curves the fact that the average cost of living has greatly increased during the last few years while the cost of electric current has been tremendously reduced. This demonstration was further supplemented by a number of types of illuminating units which have been used during the last fifty years starting with the tallow candle, followed by the dirty oil lamp, then gas burners and carbon lamps and so on up to the latest type of tungstens.



Showing marked increase in cost of electricity.

Ontario Municipal Electrical Association

At a recent meeting of the Ontario Municipal Electrical Association held in the City Hall, Toronto, the following resolution was passed unanimously:—"In view of the comprehensive schemes outlined by the Dominion Government for the creation and improvement of waterways in connection with the St. Lawrence River, Welland Canal, French River, Sault Ste. Marie, Trent, Ottawa and others, involving a large expenditure of public money, and in view of the extensive power developments which are possible in consequence thereof, also in view of the rapidly increasing power requirements of the province, be it resolved that this association request the Dominion Government to put all such water powers under the jurisdiction of the Hydro-electric Power Commission of Ontario, to be developed by them for the use of the municipalities of the province for the benefit of the people."

A by-law is being submitted in Fort Frances authorizing the expenditure of $10,000 on an electric light and power plant.

New Consolidated Tungstolier

The new consolidated Tungstolier line which has just been introduced, is to a certain extent quite similar to the Tungstolier Company's folding line—which has made a name for itself among contractors, dealers and central stations

4-light round tubing "Consolidated."

from coast to coast. While the consolidated line does not "fold," it is designed in such a way that it comes all wired and two minutes makes a consolidated Tungstolier ready for installation. Herewith is shown cut of a four-light round tubing consolidated Tungstolier. The "no iron pipe" policy is carried out in the consolidated line as was the same feature in the folding line.

Decorative Lamp Designs

A number of very attractive designs have been added recently to the lines of glassware manufactured by the MacBeth-Evans Glass Company, two of which are shown herewith. These are specially designed for use in living rooms

Both efficient and decorative

or libraries in that a good amount of general illumination is combined with a highly decorative effect. The lamps shown are manufactured in different colors to correspond with the desired general scheme of decoration of the room.

The Dirt-less Workman

A valuable little booklet with the above title is being distributed by Mr. G. J. Beattie, electrical contractor, 72 Victoria Street, and secretary of the Electrical Contractors' Association of Toronto. The little booklet does not dwell so much on the value of electricity when it is once installed, although these advantages are pointed out, but emphasis is laid upon the fact that the work of installing electric wiring, outlets or fixtures in the home does not carry the same objections as the installation of plumbing or decorations of various kinds. Electrical operations can be carried on without inconveniencing the occupants of the home or destroying their comforts in the meantime, and a number of hints are given in this little booklet as to how these results are being accomplished by successful workmen. This booklet should go a long way toward disabusing the mind of the average householder of the idea that the entrance of electrical workmen into the home means either inconvenience to himself or disturbance to any part of his household property. The electrical worker with average caution has no excuse for being anything other than a dirt-less worker.

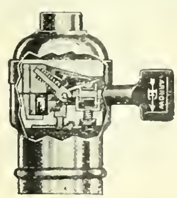
Metal Mouldings

The National Metal Moulding Company have issued a new bulletin describing various of their products. These include metal moldings and fittings of various types, some of which are shown in the accompanying illustrations. Other

products of this company include snap switches, switch boxes and bases, cover plates, couplings, bushings, clamps, etc.

660 Watt Key Socket

The Arrow Electric Company, Hartford, Conn., have placed on the market a 660-watt key socket, with quick-make and-break mechanism. The accompanying illustration shows



Arrow-E.

a sectional view of the socket, illustrating the mechanism. The rapid development of current-consuming devices has brought about the need of a socket with a greater capacity than the ordinary key socket, and it is to fill this need that the new socket has been designed.

The Elkins Glass Company

The Elkins Glass Company have developed a type of glassware which is claimed to approach very nearly to the totally indirect system of lighting. The finish on the inner side of the glass is such that it reflects practically all the light shed upon it, allowing only sufficient to pass into the glassware to produce a pleasing effect when observed from below. A very ingenious type of holder has been devised

Typical Vesta Glass Bowl

for this glassware each of the three or four holders used on any unit being a combination of a bowl-holder and a lamp-holder. In this way the conducting wires pass down the fixture chains and direct to the lamp so that there is no necessity for a drop cord or other central suspension for holding the lamps in place. The accompanying illustration shows one of their "Vesta" glass bowls for semi-indirect lighting.

Handsome Lamps

The Pittsburgh Lamp, Brass & Glass Company have recently evolved some lamps of very handsome design, two of which are shown herewith. Fig. 1 is known as the bungalow lamp and has been specially designed for the jewelry trade as giving ample illumination at the point required and adding at the same time, on account of the decorative design, to the attractiveness of the store. This bungalow lamp

Fig. 1—Bungalow Lamp

is a two-piece fixture, being composed of a heavy metal base on which the glass dome rests. There are no screws necessary to hold the dome in place and the weight of the lamp is se adjusted that it will not tip over.

The Pittsburgh Lamp, Brass & Glass Company are unlike other firms in that they manufacture both the brass and the glass for their fixtures, of which they are now one of the biggest and most exclusive manufacturers in America, having three factories in the Pittsburgh district. The trade mark of the company, "Pilabrasco," which is a combination of the first letters of the company's name, has proven a great success in advertising their products. In addition,

Fig. 2—Reading lamp or for general room

the salesmen of the company recently formed what is known as the Pilabrasco Club, which is already well known from coast to coast.

Refillable Fuses

The A. F. Daum Company have always been prominent in the development of refillable fuses for electric light and power circuits and the illustrations herewith represent their latest type, which for simplicity and rapidity in replacing the fuses surpass anything yet placed on the market. The earlier type of the Daum refillable fuse had the brass cap

Fig. 1—Latest type refillable fuse

threaded over the hard rubber casing. This was objectionable to some extent and a more recent type has been developed where the brass cap is held in position by being threaded to a screw hook which in turn is held in place by setting into two holes bored in the rubber cylinder. The compact appearance of the fuse is shown in Fig. 2.

This company is now developing a fuse in which the wire will be kept under tension so that warping will be pre-

Fig. 2—Fuse assembled

vented. The ordinary fuse wire as it becomes heated by excess current increases in length, thus removing all strain. As a result the fuse wire does not part until the temperature becomes so high that the wire is red or even white hot. Under a slight strain, however, sufficient to prevent the wire from warping, the break occurs before the temperature has been raised sufficiently to even redden the wire. It is with

these facts in mind that the A. F. Daum Company are now developing their latest fuse.

Insulator Supports

The accompanying illustrations represent different types of universal insulator supports manufactured by the Steel City Electric Company. These are specially designed malleable iron clamps for securing insulators to open steel frame work for wiring mills, foundries, factories, shops, bridges, piers, elevated railways, subways, train sheds and similar

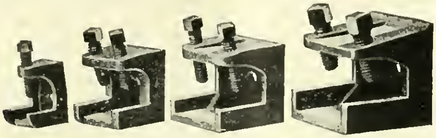


Fig. 1

structures. They are easily attached and by their use electric wiring for lights, motors, generators, cranes, etc., can be installed with a considerable saving of labor and material. Fig. 1 represents a number of different sizes of these insulator supports and Fig. 2 shows the same supports with insulators attached. If necessary two insulators can be

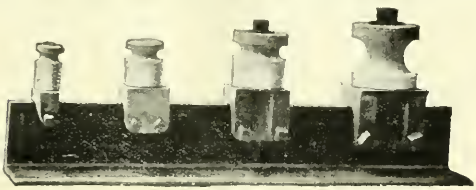


Fig. 2

fastened to each support to carry two circuits or for supporting heavy cables.

In addition to insulator supports the Steel City Electric Company manufacture fixture stems and beam straps; bushings and locknuts, conduit benders; floor outlets; outlet boxes, etc.

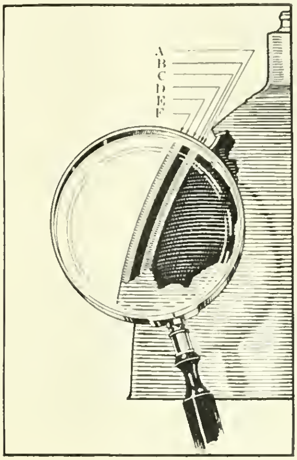
Electrical Exhibitions

Two electrical exhibitions are being held in Montreal and Toronto respectively. The dates of the Montreal exhibition are November 1st to 8th, and Toronto November 10th to 15th. The Montreal exhibit is being shown in the Arena, St. Catherine Street West, and the Toronto one in the Arena, Mutual Street, both buildings being well suited for the purpose. The object of the exhibitions is to demonstrate to the public the uses and developments of electricity in its various modern applications. The use of electricity in the home, the factory, on the farm and in medicine and surgery will be demonstrated in both exhibitions, and there will be numerous scientific and interesting special features. An idea will also be given of the general use of electricity, as for example, by showing an electrical home with occupants, an electrical farm and an electrical hospital equipment.

"Cleanezy" Finish

The "cleanezy" aluminum finish reflector illustrated in the accompanying reproductions is a special recent development for industrial lighting by the Holophane Company, Limited. Reflectors of the ordinary aluminum finish show a marked depreciation in efficiency after a short service as a result all dirt particles, which it is almost impossible to remove, becoming lodged in the pores of the coating. In the "cleanezy" finish the transparent coating "A" (see Figure) forms a smooth protective surface which does not collect dirt readily and is easily cleaned either with soap and water or with diluted ammonia.

As shown by the magnifying glass in the illustration the various coatings are as follows—coat (E) a high temperature non-absorbent coating, first applied by an experienced hand and baked; coat (C) a high temperature white reflecting base is next applied and baked; then in succession coat (F),



a smooth green exterior finish; coat (B) a high efficiency reflecting coat of matte aluminum and coat (A) a transparent, washable, protective coating are applied. Each coat is baked separately as it is applied. There are thus five thicknesses of protective coating at the point where, in ordinary reflectors, rust is most likely to form. In the figure, (D) indicates the special open-hearth steel shell.

Stuart-Howland Company

Thirty-five members of the Stuart-Howland Company's eastern sales force were given a dinner by the company at the City Club, Boston, on Friday evening, September 26th. The toastmaster was Mr. Geo. H. Wahn, sales manager, and addresses were delivered by the president, Mr. Stuart, the secretary, Mr. McDonald, and by many of the salesmen, the keynote of which was general efficiency and "team work." The addresses were interspersed by the singing of college songs, etc., by all present and everything went to show strong loyalty to the company and a particularly good and friendly feeling in its sales force. The Stuart-Howland Company are one of the largest and most progressive electrical jobbing houses and their rapidly increasing business forced them recently to move to larger and more commodious quarters at 131-141 Federal Street.

The Ottawa Municipal Electric Commission have awarded the contract to Canadian Allis-Chalmers, Limited, of Toronto, for supplying 95 "Whiteway" iron posts. The new posts will be 13 feet high, with five 100 watt tungsten lamps in frosted globes, or of exactly the same design as those now in use. The new posts are for the extension of the "Whiteway" system on Sussex and Albert streets and Laurier and Gladstone avenues. About two blocks on each of these thoroughfares will be supplied with the new lighting. The posts will be erected every 75 feet on both sides of the streets.

Montreal Electrical Society

The members of the Montreal Electrical Society opened their winter season by a reunion on Monday, October 6th, at the Edinburgh Cafe, which has been secured for the entire winter, the meetings being held on the first and third Mondays of each month. Mr. Nicholson, the president, reviewed the history of the society and outlined the programme of the coming session. In addition to the list of papers given in our last issue, the following have been arranged for: November 3, Mr. L. R. McDonald, of X-Rays, Limited, "X Rays"; December 1, Mr. W. J. Camp, assistant manager C. P. R. telegraph department, "Telegraph Talk"; January 5, Mr. C. A. Ablett, general manager, Siemens Company of Canada, Limited, "Rolling Mill Equipment"; February 16, Professor Grey, McGill University; March 2, Mr. C. A. Howe, "Recent Advances in Illumination." Mr. W. C. Lancaster, electrical engineer for the C. N. R. tunnel, has also promised a paper; Mr. Coombes, of the Babcock and Wilcox Company, will speak on "Boilers," and Mr. F. C. Burnett, of the Canadian Cement Company, on "Industrial Applications."

Imperial Soldering Paste

The Canada Metal Company, Limited, of Toronto, are putting on the market a line known as the Imperial Soldering Paste which will appeal to all electricians. Before offering this paste for sale the company sent free samples to many of the largest users in the Dominion and reports following a number of trials have been highly satisfactory. It is claimed that this soldering paste is up to the usual high standard of goods manufactured by this company.

Trade Publications

Trolley Guards—A descriptive card issued by the Ohio Brass Company, describing their National railroad trolley guard and explaining its advantages.

Travelling Blocks.—A pamphlet issued by the Herbert Morris Crane & Hoist Company, descriptive of the Morris travelling chain blocks with worm gear.

Electrical Specialties—Bulletin No. 5, issued by the Tregoning Electric Manufacturing Company, of Cleveland, Ohio, describing attachment plugs, rosettes, and receptacles.

Sewing Machine Motors.—Bulletin No. A 4102, issued by the Small Motor Department of the Canadian General Electric Company, describing sewing machine motors for family size machines.

Knife Switches—Bulletin No. 19, issued by the Frank Adams Electric Company, St. Louis, describes various types of knife switches, fuse blocks, fuse terminals, etc., manufactured by this company.

Motors—Bulletin Nos. 101 and 102, issued by the Electric Manufacturing Company, St. Louis, describing with illustrations the advantages, construction and uses of this company's single phase and polyphase motors.

Hubbell Devices—Bulletins have just been distributed by the R. E. T. Pringle Company which describe a number of recent Hubbell productions. These include motor attachment plugs—all composition; ceiling pull switch rosettes; multi-pole attachment plug with two outlets and Edison lamp base; and Hubbell attachments for pull sockets.

Aluminium Bus-bars—Bulletin No. 33, issued by the British Aluminium Company, Limited, from their Canadian office. The bulletin deals with the erection and jointing of aluminium bus-bars and connections and is well illustrated.

Separators—Section A. on live steam separators issued by the Harrison Safety Boiler Works for whom the Canadian Allis-Chalmers, Limited, are Canadian agents. Sections B. C. D. and E. describe other types of separators manufactured by the same company.

Small Motors—Bulletin issued by the Canadian General Electric Company, describing their drawn steel type of fractional horse power motors, with applications. The applications outlined in the little booklet include sewing machines, buffing and grinding outfits, portable drills, washing machines, hat cleaners, small house pumps, etc., etc. For this work motors ranging in size from 1/50 to ¾ of a horsepower are necessary.

New Companies

The Titan Electric Supply Company has been registered.

Lafreniere & Bissonnette, electricians, have been registered.

The Murphy Electric Company, Limited, has been incorporated with head office Victoria, B.C.

The Ogden Electric Manufacturing Company, Limited, has been incorporated with head office Toronto.

The Canadian Krantz Electrical Manufacturing Company, Limited, has been incorporated with head office in Toronto.

The Hamilton By-product Coke Ovens Company, Limited, has been incorporated and will establish a plant in Hamilton for the manufacture of coke and the utilization of the byproducts. The plant will be electrically equipped.

The Upper St. Lawrence Power Company, Limited, has been incorporated under a Dominion charter, at a capital of $3,000,000, with head offices in Toronto. The operations of the company may be carried on in the Dominion of Canada or elsewhere. The law firm of Blake, Lash, Anglin and Cassels, of Toronto, are solicitors for the new company.

New Books

Overhead electric power transmission, principles and calculations—by Alfred Still, M. I. E. E., etc., associate professor of electrical engineering, Perdue University. McGraw-Hill Book Company, Inc., 239 West 39th Street, New York, publishers. Price $3.00 net. The subject of overhead transmission is treated mainly from the point of view of the engineer whose duty it is to make the necessary calculations and draw up the specifications. Nevertheless the book deals also with the fundamental principles and scientific laws which determine the correct designs of overhead electric transmission lines and will be found to meet the needs of the practical engineer. It has been the aim of the author to give the reason of things—to explain the derivation of practical methods and formulae—in the simplest possible terms; consequently higher mathematics has been avoided but vector diagrams and trigonometrical formulae have been freely used in the solution of the problems. The book should, therefore, be useful not only to the practical designer of transmission lines but also to engineering students who are specializing along the lines of power generation and transmission.

Transformer Practice—by William T. Taylor, M. I. E. E., etc. McGraw-Hill Book Company, Inc., Publishers. Price $2.50 net. The author deals with manufacturing, assembling, connection, operation and testing of transformers in this second edition of a work which was originally published in 1908. The work is particularly intended for those who are operating or constructing plants or transformers and is written with a view to assisting engineers out of certain operating difficulties which can be readily solved by some temporary arrangement of apparatus in hand such as using certain changes of phases. The book is full of useful hints for the operating and constructing engineer.

Current News and Notes

Brandon, Man.

The construction of a $100,000 telephone exchange which was to have been carried out by the Manitoba Government has been postponed until next year.

Calgary, Alta.

The city council have closed a five year's agreement, with the Calgary Power Company, to purchase 5,000 h.p. per year at $26.00 per h.p. year.

Charlottetown, P. E. I.

The Charlottetown electric light plant has been purchased by the Maritime Trust Co. This is the same company which recently acquired the Yarmouth Street Railway Company's system.

Cookshire, Que.

The Westbury Electric Light & Power Company, H. A. Worby, manager, have just completed two large cement ice breakers and a large forebay with wall rising about 12 ft. above the medium water mark and having a total height of forebay wall of 30 ft.

Donnaconna, Que.

The Donnaconna Paper Company of Donnaconna, Que., have ordered electric motors ranging from 150 h.p. downwards and aggregating 1,330 h.p., from the Canadian General Electric Company.

Dundas, Ont.

The Dundas Hydro-electric Commission have contracted to erect 30 ornamental standards in West Hamilton.

Edmonton, Alta.

It is understood that the price of the street railway fare will be increased to 5 cents straight, with the exception of workman's tickets which will be accepted between 6 and 8 in the morning and 5 and 7 in the evening. School-children's tickets will continue to be sold in books of 50 for $1.25.

Elora, Ont.

A by-law will be submitted on November 3rd to authorize the expenditure of $10,000 on a distribution system. A line will be run out from Guelph sub-station.

Estevan, Sask.

The by-law submitted on September 23 authorizing the expenditure of $46,000 on an electric lighting and power system carried.

Fergus, Ont.

A by-law will be submitted on November 3rd to authorize the expenditure of $16,000 on a distribution system. A line will be run out from the Guelph sub-station.

Gravenhurst, Ont.

The Gull Lake Lumber Company has been incorporated with head office at the town of Gravenhurst. Among the objects of the company are included the generation and distribution of electrical power and the transmission and operation of tramways necessary for the company's business.

Iroquois Falls, Ont.

The Abitibi Pulp and Paper Company have placed with the Canadian General Electric Company an order for electric motors ranging from 400 h.p. downwards and aggregating 2,165 h.p., for their new mills at Iroquois Falls, Ont.

Kelowna, B.C.

The Forestry Department report that the telephone line from Kelowna to the summit of Little White Mountain has been completed. This line puts the forestry department in touch with the best lookout point in the Okanagan district. From the top of the Little White Mountain a splendid view can be obtained of the Okanagan and Kootenay Valleys. The line is 30 miles long. It is composed partly of the Okanagan Telephone Company's line, partly of the South Kelowna Land Company's private line and partly of a trail line built by the department through virgin spruce forest.

Kingston, Ont.

The Corporation of Kingston, Ont., have decided to construct a system of underground conduits upon four of the principal streets, leading from the water front to the up-town district, thus abolishing the unsightly poles. The light, power and telephone wires will be laid in the ducts, which will be of the square bore type. The system of conduits has been designed by the Ontario Hydro-electric Commission, and the work will be carried out under the supervision of the Civic Utilities Committee. A feature will be the large number of small service manholes, thus doing away with the length of service connections into the buildings. It is intended later to instal a system of standard lighting in connection with the conduits. The contract has been awarded to Dietrich, Limited, of Montreal.

Lacombe, Alta.

The municipality of the town of Lacombe will install a twenty-five light series arc system with six series, six ampere, tungstens. The requirements will include panel and instruments, lamps and regulators.

Langham, Sask.

The new electric light plant was placed in commission on September 15th.

London, Ont.

A new 10,000 line switchboard was recently placed in commission in London, Ont., by the Bell Telephone Company. The switchboard is located in an addition recently built to the company's original exchange.

Montreal, Que.

The Canadian Crocker Wheeler Company announce the removal of their Montreal office to the new McGill Building, Suite 607.

The British American Electric Company has been dissolved.

The city council has granted the request of the Montreal & Southern Counties Railway Company for certain extensions to their car lines.

A public offering of $4,500,000 Bell Telephone bonds, on a 5.15 per cent. basis, was over-subscribed on the day of issue. This will enable the company to go ahead with some extensions which were held up, pending fresh capital.

The following contracts have recently been awarded to Dietrich, Limited, Montreal.—the electrical installation of two large round-houses for the Grand Trunk Pacific at Parent and Fitzpatrick, P.Q.; power and lighting equipment of the Guarantee Building, Montreal; electrical equipment of the new Canadian Fairbanks Morse building, Montreal; electrical conduits for the northern extension of Windsor Station, C. P. R., Montreal; underground conduits and illumination by cluster lights of the Champ de Mars, Montreal; a similar contract at St. Johns, P.Q.; the illumination of the new race-course at Dorval, P.Q.; laying and supply of conduits, Kings-

ton, Ont.; and the installation of the electrical fixtures of the Read Building, Montreal.

The Montreal Electrical Service Commission expect to have the wires placed in the underground conduits on St. Catherine Street by May 1st next. The commissioners have therefore suggested that the city council should pass a by-law requiring that all buildings erected, and to be erected, on this and other streets should be wired to suit the underground distribution. All customers for electric light or power must change their interior wirings to the satisfaction of the Canadian Fire Underwriters' Association.

The Canadian Fire Underwriters' Association, Montreal, have opened an office in the Hochelaga Bank Building, Three Rivers, P.Q., with Mr. A. Pruneau in charge. This branch office will deal with the inspection of electrical work in the district.

The construction of lines on new routes and the improvement of the permanent way have resulted in the acceleration of the service of the Montreal Tramways Company. This mainly relates to the central district, and the City Council are desirous that the company shall give better accommodation in the outer wards. At an informal conference between the Council and the Controllers, the latter were asked to prepare a report on the extension of the street car service, and on the opening of new car routes to meet the demands of the outside wards.

In connection with the underground conduits nearing completion on St. Catherine Street, Montreal, Mr. A. Parent, superintendent of the civic lighting department, has prepared a report for the controllers recommending a new lighting scheme. The removal of the poles makes this imperative. Mr. Parent favors the single light standards in preference to five cluster lights, the tests made leading to the conclusion that one powerful light on a suitable standard gives a more effective distribution than the cluster system. Mr. Parent proposes to increase the present number of 57 arc lights, 350 feet apart, and suspended on wooden poles to 142 and to place them alternately on either side of the street, reducing the space to 150 feet between each lamp. The standards will be of iron, about 14 feet high, and the arc lamp on the top will be without a reflector, throwing the light higher up than at present. It is suggested by Mr. Parent that the single light standards should be installed in the down-town streets as soon as the conduits are constructed, but that in residential streets clusters might be used.

Summing up, Mr. Parent recommends the inverted magnetite arc lamp for the following reasons: as being cheaper in capital and operating costs; as being superior from a commercial and artistic standpoint; as being more suited to the crowded conditions of the principal business streets; and as being suited to the present equipment of the Montreal Light, Heat and Power Company and the city's contract with that company.

The Canadian British Insulated Company, Limited, Montreal, have just done a smart piece of work in cable laying for the Shawinigan Water and Power Company. The cable is No. 2 B and S three conductor paper insulated lead covered and armoured for submarine purposes, 4,300 feet in length, and 12,000 volt working pressure, tested after being installed at 25,000 volts. It is being used as a transmission line from the north to the south shore of the St. Lawrence, and was laid across the river from Lanoraie, P.Q., to the Sorel Electric Company. The cable was placed on a scow, and laid from one end to the other in exactly 20 minutes.

Mr. A. E. Grant, in addition to being appointed managing director of the Canadian British Insulated Company, Limited, Montreal, has later been elected president, in succession to Mr. Lawford Grant, who has now entirely severed his connection with the company.

Moose Jaw, Sask.

The new 1,500 kw. generator being supplied by Messrs. Willans & Robinson and which was expected to be in operation by October 15th has been delayed and will probably not be operating much before the new year.

Neepawa, Man.

The by-law recently submitted asking authority to expend $18,000 on extensions to the municipal electric light system was rejected by a considerable majority.

Niagara Falls, Ont.

The Electrical Development Company, who have now practically completed the installation of all the units for which the power house is designed, have closed a contract with a United States company and will export another 46,000 h.p.

North Sydney, N.S.

A contract has been awarded by the Western Union Telephone and Telegraph Company for laying five miles of underground cable with a manhole every 1,000 yards.

Ottawa, Ont.

The Ontario Hydro-electric Power Commission have submitted their plans to the Dominion Government for a high tension transmission line across the St. Lawrence River. This line will carry power to be purchased from the New York and Ontario Power Company who have a plant at Waddington, N.Y.

Pitt Meadows, B.C.

Electric power will soon be supplied to this section by the Western Canada Power Company who are running a line through this section in order to reach certain properties further north.

Portage la Prairie, Man.

Negotiations are still proceeding regarding the supply of power at this point. The city of Winnipeg offer power at $20 per h.p. year but Portage la Prairie would be required to build their own transmission line and distributing system.

Prince Albert, Sask.

Contracts have been let to Messrs. Kilmer, Pullen & Burnham for the supply of generators for La Colle Falls water power development.

Regina, Sask.

The operating returns of the street railway system of Regina for the week ending September 20th showed a revenue of $3,437 and the number of passengers carried 83,674. For week ending September 27th corresponding figures were $3,590 and 88,581.

Sidney, B.C.

A contract has been drawn between the Sidney board of trade and the B. C. E. R. Company regarding the installation of a street lighting system in Sidney.

St. Thomas, Ont.

An agreement has been signed between the Michigan Central Railway Company and the city of St. Thomas, whereby the latter supply the company with electric power up to 1,200 h.p. for their shops in St. Thomas. It is understood that the city is also negotiating with the Pere Marquette Railway Company for a similar contract.

St. Catharines, Ont.

Work is progressing favorably on the electric railway line of the Niagara, St. Catharines and Toronto Railway Company, which will connect St. Catharines with Niagara-on-the-Lake. This is an eleven mile extension which it is expected will be in operation before the winter sets in.

St. Marys, Ont.

The light and power commission at a recent meeting decided to replace the present street lighting system with orna-

mental tungsten clusters. In addition, a number of 100 c.p. single units will be installed.

Stayner, Ont.

Hydro-electric power supplied from the Severn River was turned on in Stayner on September 25th.

South Vancouver, B.C.

The South Vancouver municipal council have unanimously passed the following resolution:—"That in the opinion of this council the establishment of a municipal electric plant is a pressing necessity, and would prove of great advantage to the interests of the municipality.

Toronto, Ont.

The Interprovincial Engineering and Contracting Company has been incorporated with head office at Toronto.

The Ontario Railway and Municipal Board have issued further orders for the Toronto Suburban Railway Company to proceed with their extensions on Pacific Avenue.

The Forest Hill Railway Company are asking the government for permission to proceed with the construction of their line, and it is expected work will commence shortly.

The Municipal Electrical Association expressed approval of the organization of a purchasing and testing department to be controlled by the Hydro-electric Power Commission of Ontario for the purpose of supplying the various municipalities with necessary equipment at very low rates.

The Upper St. Lawrence Power Company, Limited, has been incorporated with head office Toronto.

Transcona, Man.

In connection with the distribution of light and power in Transcona, an order was handed down last week by Judge Robson which calls for the adoption of a principle of joint ownership for pole lines in the town.

The Canadian Crocker-Wheeler Company, of St. Catharines, have been awarded the contract for motors and auxiliary electrical equipment required by the G. T. P. shops situated here.

Vancouver, B.C.

The B. C. E. R. Company have increased their rates in and around Vancouver and Victoria to 5 cents straight with certain limited hour special rates. It is claimed by the company that this has been rendered necessary as a result of the increased cost of operation. At the same time considerable reductions have been made in the lighting rates in a number of Vancouver suburbs, placing the latter in line with the rates charged in Vancouver city.

The Bell Telephone Company have just issued a new directory, which shows 53,000 subscribers. The increased size of this directory has made it necessary to enlarge the pages so that two columns of names are now given on each page, and the thickness of the book has in this way been considerably reduced.

Victoria, B.C.

The Canadian Collieries (Dunsmuir), Limited, have decided to install an extensive electrically driven pumping system. There will be four separate units. Two will be driven by 75 h.p., a.c. motors and a third by a 75 h.p. d.c. motor, each unit being capable of delivering 350 gallons per minute against a head of 370 feet. The fourth unit consisting of two pumps working in series will deliver 350 gallons per minute against a head of 740 feet. The pumps will be built by Canadian Allis-Chalmers and the motors by Canadian General Electric Company.

Welland, Ont.

The Hydro-electric Power Commission of Ontario are commencing construction work on a 46,000 volt transmission line between Niagara Falls and Welland to serve manufacturers in the latter district. The line will be designed for an ultimate capacity of 50,000 horse-power.

Work is reported to be progressing favorably on the extensions to Parkway Heights and along West Main Street of the Niagara, Welland and Lake Erie Railway Company.

The Hydro-electric Power Commission of Ontario have placed an order with the Canadian General Electric Company, for six transformers each 3,500 kw., 46,000/2,300 volts. These are to be used in Welland in connection with the new 46,000 volt line to be constructed from Niagara Falls.

Westmount, P.Q.

The Westmount council have appropriated $25,000 for street lighting for the coming year. The council are carrying out a new scheme of lighting which will soon be in operation.

Woodville, Ont.

The sum of $4,000 will be expended on an electric distributing plant.

Winnipeg, Man.

A contract has been awarded for a quantity of lead covered cable to the Imperial Wire & Cable Company.

A number of carbon flaming arc lamps are at present undergoing a test by the city of Winnipeg with a view to their adoption for street lighting purposes in certain sections of the city. A great performance is claimed for these lamps by the manufacturers and they have the additional advantage of operating on alternating current circuits.

Tenders have been called, by the City of Winnipeg, for the manufacture, delivery, installation and testing at the Grand Trunk Pacific shops at Transcona of transformers and switching apparatus; also for the manufacture and delivery of two 44 kv.a. induction feeder regulators and accessories.

Public Utilities Commissioner Robson is, with the assistance of expert engineering advice, making an investigation of the merits and demerits of the grounded secondary system of distribution and has called upon the officers of the Winnipeg Electric Railway Company and the Light and Power Department of the City of Winnipeg to submit reasons why an order should not be made enforcing the adoption by them of this system. The system of grounding has been ordered and adopted by a number of municipalities and Judge Robson feels that, unless existing conditions in Winnipeg are such as to render the adoption of this extra precautionary measure unnecessary, such an order should be issued. A number of conferences between the two operating companies and Judge Robson have been held, and it is expected that a definite arrangement will be made within a few days.

While passing through the city of Winnipeg recently, Sir William McKenzie was interviewed regarding the rumors in connection with the sale of the street railway system. He admitted that offers for the concern had been received on different occasions, and stated that although it might be sold there was at present no transaction in the air for its sale.

Westboro, Ont.

By a majority of 51 votes the ratepayers of the village of Westboro have decided to award the contract for lighting the streets of the village for the next ten years with 60 100-watt tungsten lamps at $13 per annum per lamp to the Ottawa Electric Company. The total number of votes cast when the by-law was submitted was 72. The poles for the lamps have been in place for some time. The company has commenced to install the lamps.

The Canadian Union Electric Company, Limited, beg to announce that Mr. W. H. Bytham has resigned his position as manager of their Montreal branch to take up a directorship in the firm of The Electrical Repair & Contracting Company, of Montreal. For the time being Mr. Curling is in Montreal, looking after the interests of the company but shortly a fully equipped engineer will be appointed to fill Mr. Bytham's place.

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Trade Prospects for 1914

We are again approaching that season of the year when it is the general custom to take stock of the last twelve months' business and make plans for the next season. For this reason, as well as for the fact that the past year has been attended with very unusual conditions, a few remarks on the trade outlook for the coming year will be opportune.

Whether or not the year 1914 will be an active period for us industrially, depends, in the main, on two factors: (1) the natural demand for manufactured products, and (2) our financial ability to purchase these products. Without question there is only one answer to the first. Canada's capacity for almost unlimited development is established beyond the shadow of a doubt, so that our manufacturers may be assured of an ever-increasing demand for practically every class of manufactured articles. It remains then to discuss only the ability of Canadians as individuals, municipalities or private companies to provide the purchase price.

During the past summer, tight money has been a very real obstacle in the way of certain lines of activity. This condition was brought about partly by the unusual requirements of the European continent; also to a considerable extent by the amount of money that had become tied up in realty investments from one end of the Dominion to the other; but these conditions were intensified by the conservative, ultra-conservative we believe, attitude of our banks. Arguing that the signs foreshadowed a repetition of the crisis of 1907 and similar previous periods, and believing that prompt action would save the situation, they have followed the policy, apparently quite consistently, of lending no money which, as they thought, could by any possible chance be used to encourage the general extravagance to which Canadians were rapidly becoming habituated—the result largely of a number of years of unusual prosperity and plentiful money which had turned the heads of a large percentage of our citizens. This action of the banks has caused a great deal of discomfort to even their most deserving customers, and while it is generally conceded that caution, in reason, was the wisest course that could have been followed, it appears to us that the banks, by taking the extreme course, have unnecessarily curtailed the circulation of money and have done much towards producing the very condition—a trade reaction—they sought to prevent. Just how far their course was justified is difficult to determine, and it has undoubtedly placed the banks in a sound position so that at no time have they had to refuse assistance for developments which, in their own judgment, they have considered necessary. As a result the larger industrial life of the country has not suffered seriously, nor is there any sign of it in the future, for want of sufficient capital. Certain industries report the biggest year's business in their history.

How Scarce is Money?

As already indicated, the extent of the demands to be made on our factories during the next twelve months will depend on the amount of money in the hands of (1) the individuals, (2) municipalities, and (3) private corporations. Our recent bountiful harvest has been an all-important circumstance which will mean that the general public is pretty well supplied with ready money. The farmer only knows through the newspapers that money is scarce. As a result, the small retailer of general supplies such as hardware, boots and shoes, etc., except in the larger centres, will probably not experience any diminution in trade; this means continued prosperity for the wholesale dealer and manufacturer. In the building industry, is it not a fact that practically every city and town in Canada is under-supplied with both public and residence buildings; and the population still continues to increase at a rapid rate. While building permits issued during the last month or two indicate a slackening in this line of trade, this, we think, is explained in large measure by the very general feeling that both workmen and supplies will be obtainable at lower rates; also, due to tight money, a certain amount of sacrifices have been thrown on the market. We see no sign of a diminished demand, however, and this slight reaction will just mean an increased activity in building trades of all kinds as soon as the money situation has readjusted itself. With an already inadequate supply of buildings, an ever-increasing population, and a fair distribution of money among the middle classes, the demand for all kinds of building materials seems assured.

With the larger municipalities and private corporations the outlook may not be so entirely optimistic. These have found it necessary, often, to go outside of Canada for their supply of money, which has not been so readily forthcoming during the last few months, on account of similar demands from other sources. Canada's natural resources, however, constitute a splendid security which stands behind all her industrial undertakings and we are confident that, even in a world competition, she can obtain the necessary supply of capital; perhaps, just at this time, at a little higher rate, but not so high that the resultant developments will not amply justify the increased cost.

Rural Prosperity

And after all has been said on both sides Canada's immediate and ultimate prosperity is inseparably tied up with the prosperity of her great rural population, which at the present moment is possibly not equalled in any other country in the world. Our crops, just harvested, will put into the pockets of the farmers during the next few months in the neighborhood of $300,000,000. This will soon find its way through the usual channels to the manufacturers. To this sum might be added dividends from investments which are

being distributed to the general public at the annual rate of something over $150,000,000. This will also indirectly reach the manufacturer. The extent to which the natural frugality of the average citizen will assist in the readjustment of conditions is, of course, difficult to determine in dollars and cents, but there is no doubt that at a time like the present a general policy of curtailment is being followed by most of us and these accumulations will be ready for circulation as soon as the general public judges the opportune moment has arrived.

Summing up the situation, while we anticipate that difficulties will continue to be encountered for some time in obtaining large sums of money abroad, this condition, we believe, will be more than offset by favorable local factors, of which we may mention—(1) the unsatisfied demand for every kind of manufactured product; (2) unexampled prosperity of our great rural population; (3) good security and high returns of Canadian investments which means ability to borrow abroad; (4) present low conditions of stock supply; it is generally conceded that the retailer is running very low following the general policy of caution.

Guarding Electrical Contractors' Interests

By a recent act of the Ontario Provincial Legislative Assembly every municipality of sufficient size is now required to organize a municipal electrical inspection bureau (and others of smaller size are grouped in a district) and appoint an inspector, so that all rules and regulations with regard to the correct wiring as approved by the Hydro-electric Power Commission, may be carried out. Already a number of municipalities have complied with the requirement and others are only waiting the location of a suitable man. Some of the municipalities, however, have been dilatory in complying with the requirements. More or less pressure has been brought to bear by the Commission but the government as yet has taken no steps to see that its recent enactment is carried out to the letter. The question has been raised, and it is apparently worthy of consideration, whether the municipality, in case of loss to life or property, might not be held liable if it could be shown that a proper enforcement of the law would have prevented the calamity.

In the city of Toronto no inspection bureau has yet been created by the municipality. The private company has its own inspector, as has also the Toronto Hydro-electric System, and the Board of Control has contended that where there was no demand for such an appointment they were under no obligation to make it. However, the question is now being taken up by the Electrical Contractors' Association of Toronto, with the object of showing the necessity for such an appointment under existing conditions and a resolution was recently passed and submitted to Mayor Hocken favoring the establishment of a municipal electrical inspection bureau that would see to it that electrical installations must be in a perfectly safe condition before connections with the supply mains can be made. It is stated that the not infrequent experience of contractors is that connections are now being made by both systems operating in Toronto that should not be made—the result, to a very great extent, of the competitive conditions existing there.

The electrical contractors at a recent meeting further placed themselves on record as being in favor of the fee system being adopted, with the limitation that the charge for inspection for one building should not exceed $10. The argument in favor of the fee system is that this would make the department self-sustaining, which, it is claimed, would help to remove it from political influence. It was also the unanimously expressed opinion that all contractors should be licensed. This would make it possible to place the blame for poor work on the proper parties and so would make a man careful of his reputation, and would further make it possible in case any particular contractor continued to do unsatisfactory work to remove his name, if necessary, from the licensed list. In this connection it is claimed that much incompetent work is being done by so-called electrical contractors who have not the necessary knowledge and experience, and that quite often large installations of a perfectly satisfactory character are rendered unsafe through some little addition or extension by a novice.

Other suggestions made by the association were to the effect that no connections should be made to any installation without the approval of a proper inspector; that all electric lighting fixtures be inspected; and that inspection be made within one full working day of the date on which the inspection is filed.

In the meantime, of course, the inspection of the Canadian Fire Underwriters' Association covers the field as far as its authority extends but this association has no means of enforcing its regulations on unwilling customers who are always able to place their insurance risks with some company not included in the association. Such a risk, too, is often the very one that needs the most careful inspection.

In connection with the licensing of electrical contractors it may be noted that an ordinance in Chicago, effective October 1, requires all electrical contractors to be registered by the city department of electrical inspection. The initial fee is $25 and the annual renewal charge $10. Any electrician, who supervises electrical construction, must have had four years' experience at the trade. This applies to electrical contractors as well as foremen. This means a competent man in charge of every job, as it ought to be.

140,000 Volt Transmission

A bulletin has just been issued describing the properties and power developments of the Nevada-California Power Company and Southern Sierras Power Company with special reference to the most economical and efficient use of water as illustrated by this installation. The bulletin is distributed by Mr. Geo. J. Henry, of San Francisco, who supplied the hydraulic apparatus.

This development is unique in that the ultimate plans are calculated to use the water of a small mountain stream in the State of Nevada seven times over. Bishop creek has a length of about 14 miles down the mountain side, with a fall of 5,500 ft. in that distance or nearly 400 ft. to the mile. The depth of the canyon walls is in most places about 1,000 ft.

The first power house was installed in 1905 and is now known as plant number 4. This consists of 6,000 kw. capacity. In 1907 plant number 5 of smaller capacity was installed; in 1908 number 2 was built. In March of the present year number 6 was placed in operation followed one month latter by number 3. The plant to be known as number one and a smaller one to be known as plant A yet remain to be installed.

A feature of great importance in connection with these developments is a 239 mile transmission line which carries power at 140,000 volts. The efficiency of the transmission and the load factor are uncommonly high there being only a loss of 18 per cent. at 80 per cent. load factor. The cost of operation is also very low being 18 per cent. of the gross operation of the system. Steel aluminium conductors are used throughout.

The water flow varies from a maximum of 500 cubic feet per second to a minimum of 30 second feet and a system of three reservoirs is being built, two of which are already in operation.

The water is carried throughout in either gravity flow or pressure pipes, there being no open canal, ditch or tunnel. This was done for the three-fold purpose of conserving water,

getting the benefit of regulation from the intake reservoir and preventing snow and ice getting into the conduit lines.

The turbines in number 2 plant operate under a 938 feet head, and in number 3 plant under an 814 feet head.

Cannot Force Terms

Following a recent decision by Commissioner Robson that the city of Winnipeg be allowed to supply power to the city of St. Boniface, and following the refusal of the council of St. Boniface to grant permission to the city of Winnipeg to use the public roads and streets of St. Boniface for the proposed extensions of its electrical system, the city of Winnipeg again appealed to the Public Utilities Commission of Manitoba.

The city of St. Boniface submitted:

1. That the city of Winnipeg had no power to carry on a light and power business beyond the limits of that city.

2. That the dominion of the city of St. Boniface over the streets in that municipality should not be interfered with in the manner proposed.

3. That in any event there is satisfactory provision at present for the needs of that community, that is to say, by the service of the Winnipeg Electric Railway Company, who established a system there under terms imposed by St. Boniface.

As Commissioner Robson had already decided that the city of Winnipeg was empowered to carry on a light and power business beyond the limits of that city, the first objection did not stand. The Commissioner pointed out, however, that while Winnipeg may have authority to do business with another municipality it was entirely another question how they should procure permission to use the property of that other municipality. As in this case St. Boniface was not willing to grant the city of Winnipeg the right to install poles and string wires in their city and inasmuch as there is no present demand or necessity for this extra service the matter must stand in accordance with the St. Boniface application.

Abitibi Pulp and Paper Company

The turbines and generator equipment for the Abitibi Pulp and Paper Company's plant at Iroquois Falls are being supplied respectively by the Holyoke Machine Company and by the Canadian Westinghouse Company. Two generators will be installed initially. Each of these has a capacity of 1,250 kv.a. (1,000 kw., 80 per cent. p.f.), 2-bearing, water wheel type, 3-phase, 60 cycles, 600 volts, 240 r.p.m., complete with bearings, double bed-plate, shaft extensions and field rheostats to be arranged for coupling to water wheels. Two exciters 52 kw. capacity each, 125 volts, 240 r.p.m. will be installed direct connected to the generator. The Canadian Westinghouse Company will also supply a seven panel natural black slate switchboard for controlling both generators and exciters. An order has been placed with the Canadian General Electric Company for motors aggregating something over 2,000 horse power.

Western Canada Power Extensions

The Western Canada Power Company, Limited, have been proceeding with the raising of their dams on the Stave River an extra ten feet, so as to provide storage for two additional generating units. The sluice dam and intake dam have both been raised this amount and the Blind Slough dam is now being raised to the same level. Contracts were awarded some months ago to the Escher Wyss & Company, of Zurich, for the construction of two additional turbines of the capacity of 10,000 kilowatts each, which are to be delivered in April and June next respectively. The Canadian General Electric Company is constructing the generators of the same capacity. The power house building is being extended to a sufficient capacity to receive these two new units. The contract with the British Columbia Electric Railway Company came into operation on September 1st, and in addition the Puget Sound Light and Power Company is receiving power to the amount of approximately $10,000 a month. During the months of August and September there was some slackening in the demand of industrial power, owing to the financial stringency in the West, but the factories are now increasing their demand.

Prince Rupert Hydro-Electric

The powers controlled by the Prince Rupert Hydro-electric Company consist of Khtada Falls, situated 38 miles from the city of Prince Rupert, which will develop 30,636 h.p.; a power known as McKnight's, 32 miles distant, capable of developing 28,150 h.p.; and the Falls River, 38 miles distant, with a possible development of 25,000 h.p. The two former powers have a drainage of sixty square miles, and the Falls River has a drainage of 100 square miles. The company has announced its intention of developing the Falls River power first, and the others as required. It is understood that the cost of the proposed Falls River plant has been estimated at approximately $2,500,000. In the meantime, while the Falls River development is under way the company have constructed a plant at Port Edward, about five miles from Prince Rupert, and Dick, Kerr & Company, of England, have built for the company two Diesel engines of a capacity of 1,000 kw., which are now about to be shipped. These engines will be used to supply the local market temporarily, and will subsequently be used as an auxiliary plant, when the hydro-electric plant is completed.

Central Station Exhibit

During a recent exhibition in Ottawa the booth of the Ottawa Electric Company was the centre of much interested observation. As will be seen from the accompanying photo-

Ottawa Electric Co's Exhibit

graph of this exhibit, a very wide range of electrical equipment was displayed, covering the latest and most efficient types of ornamental lighting units as well as various household appliances. The Ottawa Electric Company has always been noted for their forward methods in advertising and popularising the uses of electricity and the picture shows that during the recent exhibition they were fully maintaining this reputation.

Regulations re Line Conductors

Revised regulations have recently been issued on the German requirement regarding copper and aluminium overhead conductors. These regulations come into force on January 1st, 1914, and are printed in part herewith as being of interest for comparative purposes with the regulations existing in Canada.

These regulations apply to all overhead conductors with the exception of railway feeders and short house-lighting feeders with supports less than 20 metres apart. The smallest permissible cross section for heavy metals (copper) is fixed at 10 sq. mm., and for light metals (aluminium) at 25 sq. mm. The following standard sizes are to be adhered to:—

Sect. area, sq. mm.	No. of wires in strand	Diam. of each wire in mm.	Diam of strand in mm.
10	1 (solid)	3.5	——
16	1 "	4.5	...
16	7 (strand)	1.7	5.2
25	7 "	2.1	6.5
35	7 "	2.5	7.7
50	14 "	2.1	9.2
70	19 "	2.1	10.9
95	19 "	2.5	12.7
120	19 "	2.8	14.2
150	30 "	2.5	15.9
185	37 "	2.5	15.9
240	37 "	2.8	20.1
310	61 "	2.5	22.9

The pitch or lay of the strand shall be from 12 to 15 times the diameter of the strand.

Standard materials are copper and aluminium having the following characteristics:—

Diameter of wire in mm.			Loads in kgs. which wire shall sustain 1 mi. without break.		Resistance in ohms per km. max. at 20°C	
Nom.	Min.	Max.	Copper	Aluminium	Cu.	Al.
1.7	1.70	1.75	90	...	8.0	...
2.1	2.1	2.2	140	60	5.2	9.0
2.5	2.5	2.6	200	85	3.7	6.4
2.8	2.8	2.9	250	105	3.0	5.0
3.5	3.5	3.6	380	...	1.85	....
4.5	4.5	4.6	600	...	1.15	...

The wires shall in addition show a cup-shaped formation at the point of break.

The erection tables of spans and sags are based on the assumption that under the most adverse conditions the stress on the line shall not exceed the following values:—

For solid copper 12 kgs. per sq. mm. (17,000 lbs. per sq. in.)
For stranded copper 16 kgs. per sq. mm. (22,700 lbs. per sq. in.)
For stranded aluminium 7 kgs. per sq. mm. (10,000 lbs. per sq. in.)

These values are also to be adhered to when the line is erected with spans other than those for which the tables have been calculated.

Material other than that specified above (including copper and aluminium with special properties) may be employed, provided that under the most adverse conditions the maximum stress does not exceed one-third the elastic limit for solid wires, and one-half the elastic limit for stranded conductors. The elastic limit is defined as the stress which will produce a permanent elongation of .2 per cent. after application of the load for a period of one minute.

The working stress is calculated at —20 deg. C. with no additional load, and at —5 deg. C. with additional load due to ice and snow, wind, etc., given by the formula $(190 + 50 \sqrt{d})$ grams per metre of conductor, where d is the diameter in mm. of the strand. For uncovered copper and aluminium conductors the sags and tensions should be in accordance with the tables. Where the supports are not exactly on a level, the span is taken as the horizontal distance between supports and the sag as the vertical distance measured below a straight line joining the two points of support.

All joints in the run of the cable must have a tensile strength equal to at least 85 per cent. of that of the conductor in which the joint occurs. All welded or soldered joints must be relieved of all tension.

Support of Conductors

All binding wire must be of the same material as the conductor and in the case of aluminium of the same hardness. Binders of aluminium must not be liable to be subjected to friction, vibration or cutting action. At curves the conductor shall be so arranged on the insulator that it presses on the latter instead of tending to pull away from it.

The following values have been taken in calculating out the tables of sags and spans:—

Specific gravity: copper, 8.9; aluminium, 2.75.

Coefficient of expansion: copper, 0.000017; aluminium, 0.000023.

Modulus of elasticity: copper, 13,000,000; aluminium, 7,150,000.

It was also assumed that the modulus of elasticity of stranded conductors was the same as for solid wires, which is probably correct for lines under tension.

Cedars Rapids Development Work

A progress report has just been issued by the Cedars Rapids Manufacturing and Power Company describing the work accomplished to date in connection with their hydro-electric development at Cedars Rapids. This work is in charge of the engineers of the Shawinigan Water & Power Company and of the Montreal Light, Heat & Power Company, Mr. Julian C. Smith chief engineer of the former having particular charge of the hydraulic end and Mr. R. M. Wilson, superintendent of the Montreal Light, Heat & Power Company, having the electrical work under his particular supervision. The present report deals of course with the hydraulic end principally and has been issued subject to Mr. Smith's supervision. The following extracts from the report are of special interest an indicating the fundamental features of what will probably eventually be the largest purely Canadian hydro-electric plant installed to date.

About fifty miles west of Montreal the St. Lawrence River widens out into Lake St. Francis. Above Lake St. Francis is a long series of rapids, known principally by the name of the largest one, The Long Sault. Below Lake St. Francis, and nearer Montreal, lies another expansion of the river named Lake St. Louis, and between these two lakes the St. Lawrence River falls a distance of about 80 feet, made up principally of three rapids, viz.: Coteau, The Cedars and The Cascade. Thirty-two feet of this total fall is in the Cedars Rapids, thirty miles to the west of Montreal.

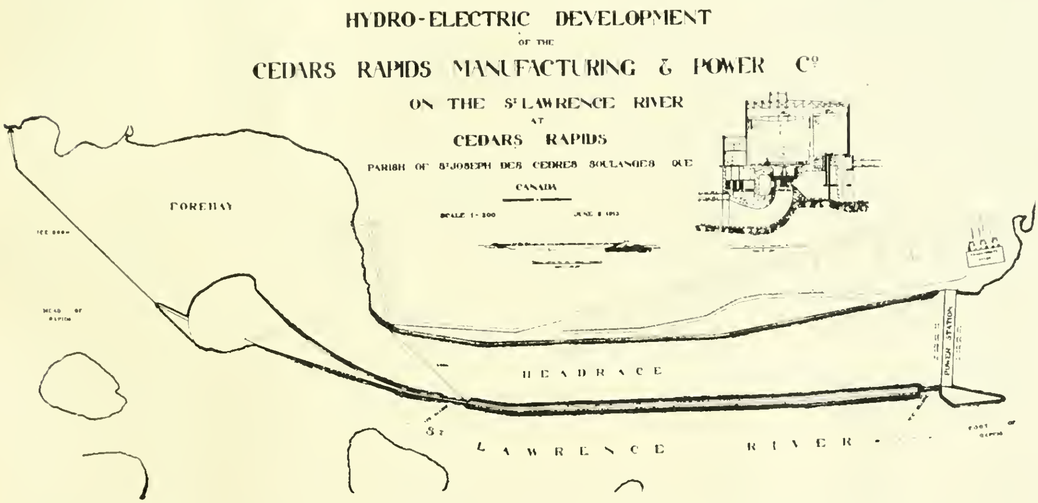
The Canadian Government has built canals on both sides of the St. Lawrence River to navigate these three rapids, that on the South being called the Beauharnois Canal, and that on the North the Soulanges Canal. The Beauharnois Canal has been practically abandoned for navigation purposes. All the traffic from the Great Lakes to the sea passes through the Soulanges.

The St. Lawrence River is one of the greatest rivers of the world; it drains a territory of about 300,000 square miles of which a very large percentage is lake area, and it is unique among all the rivers of the world in the steadiness of its flow. The ratio of the flow in the lowest and in the highest years being 3 to 1. Comparing this with the other large rivers of this continent, such as the Susquehanna which has a range of 75/1, and the Mississippi which has a range of about

25.1. it is evident that the St. Lawrence is remarkably uniform in its flow. This fact is of inestimable value to any water-power development, and it is this fact that has placed the development at Niagara Falls in a class almost by itself as regards the question of water supply. Other rivers may be developed by the construction of storage reservoirs, and in a few cases, such as with the St. Maurice River, this can be done at a reasonable expense with remarkable results, but the largest natural reservoir in the world, the Great Lakes System, provides an equalization which is not only from year to year, but from one wet cycle, extending over a term of years, through the intervening dry cycle.

For many years the development of the rapids in the St. Lawrence River has been discussed, and plans have been made based on different types of development. In view of the treaty between Great Britain and the United States, which established the International Waterways Commission, any waterpower developments made on the St. Lawrence River, are subject to the approval of the Commission. No diversion of the water from the river are permitted without careful investigation, which insures that the levels for navigation purposes are not affected.

The plan herewith shows the general scheme of development. The rapids at Cedars extend over a distance of about two miles. In order to use this fall, it is necessary to concentrate this difference of level at one point. To do this a canal is being constructed along the north bank of the river. The outer wall of the canal is an artificial bank formed of excavated rock taken from the canal section and made water-tight by clay filling on the inside.



General plan of hydro-electric development of the Cedars Rapids Manufacturing & Power Company

This combination rock-fill earth bank is being built with ample factors of safety, and special precautions are being taken to prevent leakage or possible damage to this bank. As the maximum head against the bank will never be more than 30 ft., it is evident that this type of construction, which is common throughout the world in the case of large water reservoirs, is the most economical, on account of the fact that all the materials for the construction of the bank are available at the site of the work.

The canal when finished will have its outer or south bank practically a straight line two miles long, and parallel thereto a similar bank located on the natural flow of the river, and at a distance from the south bank of about 1,200 feet. The width of the canal on the water line will be about 1,000 feet, and the total length of the canal from the ice fender above the Isle-aux-Vaches to the power-house will be about 12,000 feet. Extending across the lower end of the canal and forming a dam, is the power-house structure itself. This structure is of concrete, and in the power-house is concentrated the total fall of 32 feet given by the difference of level between the top and bottom of the Cedars Rapids.

During the past few years great improvements have taken place in the design of low head water turbines, and single runner wheels can now be built having reasonable speeds, and developing large amounts of power. The policy of the Cedars Company has been not to endeavor to obtain the largest available units; the size of the unit was chosen more within a view to economic operation and confidence in its reliability, than with the endeavor to save a small amount by greatly increasing the size. Several plants have been constructed during the past two or three years, using this single runner type of wheel with success.

The cross-section of the power-house shows the water coming into a flume which encircles the water turbine. The water passing from the side of this flume into the openings of the waterwheel operates the waterwheel by pressure against by pressure against the curve vanes, and drives the generator located immediately above the wheel. The weight of the moving parts is carried by what is known as the thrust bearing, located in this plant on top of the generator. In most vertical developments in which large units are operating, considerable trouble has been experienced with the thrust bearings.

Coincident with the development of the single runner turbine, there has also been considerable development in the designs of these thrust bearings, and there are to-day several types available which are reliable, and which do not require constant operation of auxiliary apparatus to keep the bearings from burning out.

In order to make these bearings accessible for inspection and maintenance, the bearing is located on top of the generator where it can be easily reached with the crane.

By using this design, the total overall length of the generator and waterwheel was reduced to a minimum, and this has a very considerable advantage in reducing the distance between the guide bearings which hold the shaft vertically, reducing the number of bearings to two.

This waterwheel will develop a total output of 10,800

horse-power and the generator connected to it, and located immediately above, as shown on the accompanying plan (also see February 1, 1913, Electrical News), will transform this mechanical energy into electricity. These units will operate at a speed of 55 r.p.m. and judging by the performance of wheels of similar design, the waterwheels should have a very high efficiency.

Under its Charter and contract with the Dominion Government The Cedars Rapids Manufacturing & Power Company has a right to take 56,000 cubic feet per second into its canal, which, as indicated on the plan, is practically a part of the river. This amount of water is sufficient to develop continuously 160,000 electrical horse-power. The plans for the final development call for the installation of eighteen units of a normal capacity of 10,000 horse-power each, two of these units being regarded as spares.

In addition to the main units, there will be installed six water-driven exciter units, which will be described more fully in a later bulletin. These exciter units have a capacity of 1,500 horse-power and operate at a speed of 150 r.p.m. The general design of the waterwheels and generators is quite similar to that of the main units.

The efforts of the Engineers of the Cedars Company have been to make use of the experience which they have had in the design of other plants and the operation of the plants of the Montreal Light, Heat & Power Company and the Shawinigan Water & Power Company, and to make the design as simple and as reliable as possible. One of the bad features of most vertical waterpower developments is the fact that much of the auxiliary machinery, such as governor pumps, thrust bearing pumps, thrust bearings and other pieces of apparatus which although auxiliary in a sense yet are vital to the proper operation of the plant, are located in tunnels or rooms below the generator floor.

This arrangement while it tends to make the main generator floor free from such small pieces of apparatus and therefore improves in a sense the appearance of the floor, yet has a bad effect on the operation of the plant, not only because these pieces of apparatus are difficult to get at for purposes of repairs, but also because almost always these tunnels and rooms are lighted by artificial light only, and the operatives cannot be given the careful supervision from the skilled superintendent of the plant, which would be given could he see these machines without leaving the main floor of the building.

In the designing of the plant at Cedars Rapids, an effort has been made to put on the main floor all the equipment which is at all vital to the continuity of operation of the plant.

On account of the low head and the available space it was impracticable to use a horizontal type of development. The wheels at Cedars will have a diameter of about 18 feet, and the generators will be about 36 feet in diameter.

At the upper end of the canal, an ice fender is to be constructed for keeping out floating ice which comes down from Lake St. Francis, and which if permitted to come into the channel would cause trouble.

A type of ice fender is to be used which will consist of a series of submerged openings, so that the water entering the canal must be drawn in at five or six feet below the surface. As this ice fender has the same general direction as the main current of the river, the ice will strike this fender and will be carried along down the river by the main current without entering the canal.

This fender will not, however, take care of what is known as frazil ice, and special precautions are being taken to prevent interruption from this cause. Very large units are not susceptible to the same trouble from this kind of ice as smaller units, and a very large amount of this ice will pass through the wheels as the openings through these wheels will be about 7 feet high and 3 feet wide.

M. & S. C. Ry. Sub-Stations

By Mr. Julius G. Koppel

The installation described in this article of three 500 kw. Westinghouse rotary converters, with necessary equipment of transformers, lightning arresters, etc., was made during the past year for the Montreal and Southern Counties Railway Company at their new sub-station in St. Lambert, Que. A brief description is also given of the sub-station at Chambly Basin which contains a 400 kw. motor-generator.

Power is received at 25,000 volts from a three-phase, 60-cycle line (Montreal Light, Heat & Power Company) and transformed through three sets, each of three 180 kw. single-phase transformers, oil insulated, self-cooled, 60-cycle, delta connected, primary 25,000 volts and six-phase secondary 428 volts.

At the latter voltage power is delivered to three 500 kw., 6-phase, diametrically connected rotary converters shown in Fig. 1. These machines give 600 volts d.c. 833 amp. at 945 r.p.m. and are connected in parallel to the d.c. bus-bars.

The switchboards are of black marine slate mounted on iron frames. A total of 15 panels have been installed. The control panels for the incoming lines are located immediately in front of the high tension bus, which consist of two panels for each line equipped with signal lamp, overload trip coil and two inverse time limit relays. One voltmeter is used for both lines. The oil-switches are Condit type and hand operated. Current transformers operate the relays for each group of transformers. There are two panels for controlling the a.c. side of the rotary converters; these are equipped with ampere meter, two inverse time limit relays and trip coil for the oil switches. A signal lamp is connected between the low tension starting leads of the transformer to indicate if the transformers are operating. There are three generator panels with voltmeters, ammeters and reverse current relay to oper-

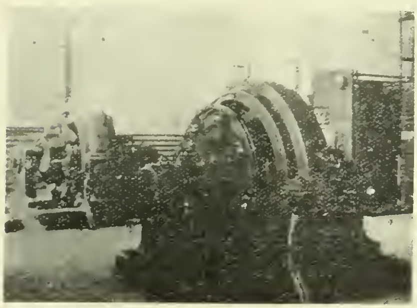
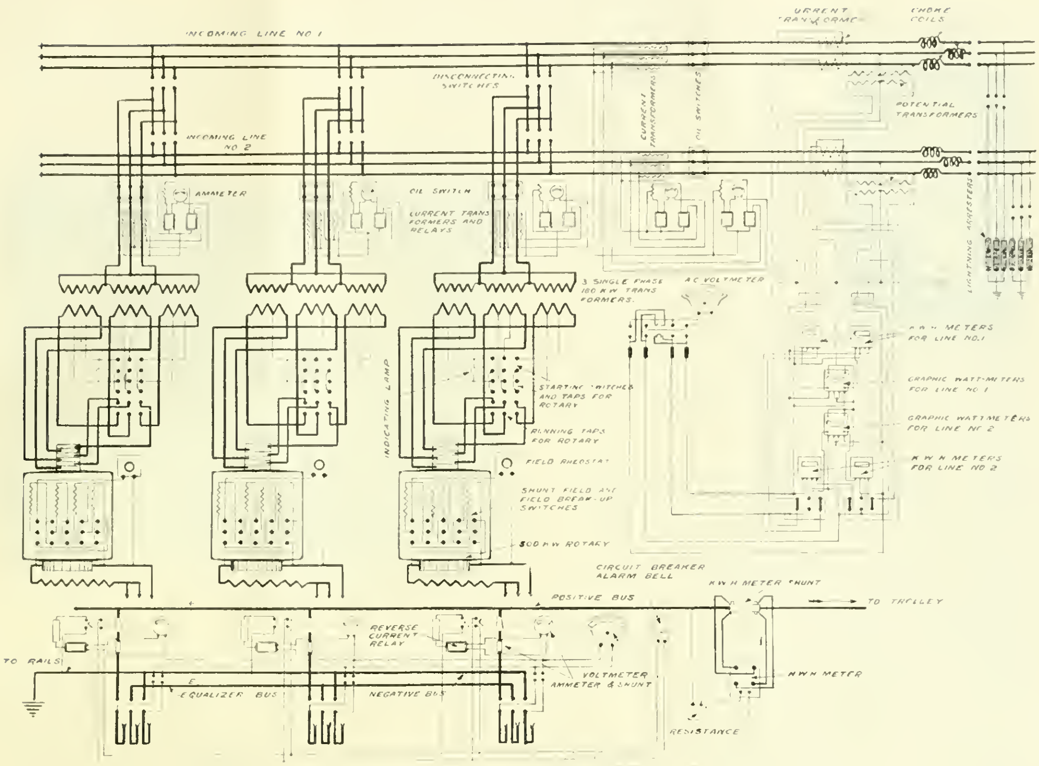


Fig. 1.—Rotary converters, St. Lambert

Fig. 2.—Motor generator, Chambly

Fig. 3.—Setting pins in insulators



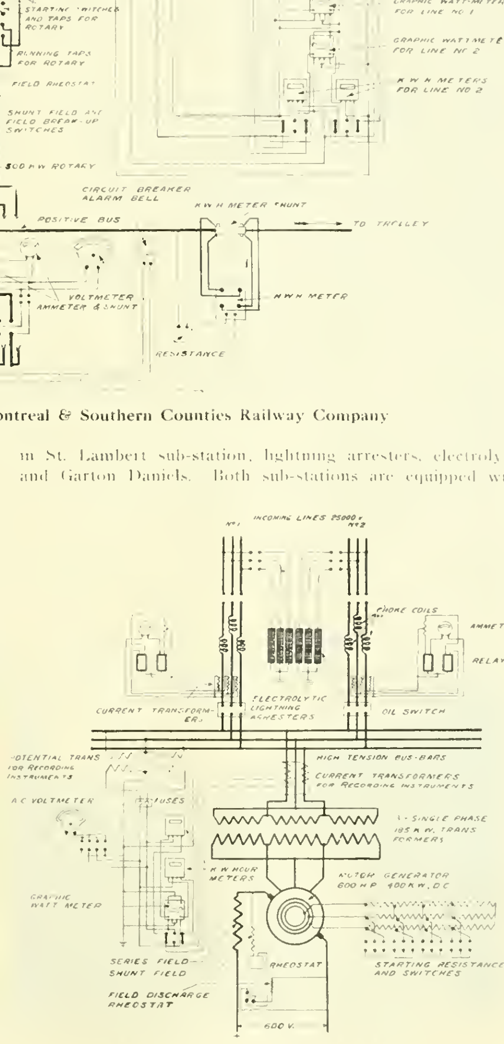
Wiring diagram, St. Lambert sub-station—Montreal & Southern Counties Railway Company

ate the circuit breakers. Four feeder panels carry ammeters, kw.h. meters and reaction coils for each feeder.

Lightning protection is afforded by two sets of air cooled choke coils and three-phase type "A" electrolytic lightning arresters, Westinghouse manufacture. The arrester tanks are mounted in a separate room and so arranged that the operator may check the discharge on each set of lightning arresters. The arrangement consists of a 250 volt a.c. gong and an air gap protector which is connected in the ground wire and the gong terminals are shunted across the air gap. In any charging or discharging of the lightning arresters a certain amount of current goes through the gong causing it to ring. The d.c. side is equipped with Garton Daniels, 600 volt, lightning arresters two for each feeder employed.

The sub-station at Chambly Basin, which is twelve miles distant, is designed to run in parallel with St. Lambert. Power is received at 25,000 volts, 3-phase, 60-cycle, and transformed through one set of three 185 kv.a. single-phase transformers, oil-insulated, self-cooled, 60-cycle, delta-connected, primary 25,000 volts, and delta-connected secondary 2,300 volts. At the latter voltage power is delivered to a polyphase induction slip-ring motor, stationary primary and revolving secondary, rating 600 h.p. The d.c. end of the motor-generator is a commutating pole, 400 kw. machine, compound wound, 600 volts.

The switchboard panels are of black marine slate. A total of 6 panels—one generator panel, 2 feeder panels, 2 line controlling panels and one 600 h.p. motor panel with oil-switches four in number, and a cast iron grid resistance group star connected; controlling devices and meters the same as in St. Lambert sub-station, lightning arresters, electrolytic and Garton Daniels. Both sub-stations are equipped with



Wiring diagram, Chambly sub-station

kw.h. meters and a graphic meter for registering the consumption of the a.c. current.

Mr. Julius G. Koppel

Mr. Julius G. Koppel to whom we are indebted for the above descriptive article on two recently installed sub-stations for the Montreal & Southern Counties Railway Company, has until recently held the position of power house construction foreman for that company. Mr. Koppel was born in Germany in 1882 and is a graduate of the government School of Technology. He has served in the government naval yard as mechanical electrician and later had charge of the electrical end of the submarine torpedo boats. Since coming to Canada in 1907 he has been engaged with various manufacturers as mechanic and electrician. Mr. Koppel recently joined the construction department of the C. P. R. Company.

New Plant at Armstrong, B. C.

Armstrong, a recently incorporated city of fifteen hundred inhabitants situated in the north end of the famous Okanagan Valley of British Columbia has one of the most complete power and lighting plants to be found in Canada.

Normally the plant is operated by water power from Davis (or Fortune) creek, the water being utilized for domestic supply after giving up its energy to the turbine wheels. The creek having its rise in the higher altitudes of the Aberdeen Mountain is liable to great fluctuations in flow, the minimum being during cold weather when some of the smaller tributaries are completely frozen over. During this minimum flow period power is generated by Diesel engine, thus rendering a continuous service every day, including Sundays.

Since inaugurating the continuous service the power load has steadily increased, the average daily load factor being now fifty-four per cent.; load factor in this case being the ratio of average to maximum demand.

The power house, a reinforced concrete fireproof structure with Underwriters' wired glass windows and steel-covered doors, is located three miles from the city, the electric power, and domestic water supply, being carried over and under city right-of-way the intervening distance. The equipment of the power house includes the hydro-electric unit, oil engine unit with accessories, and switchboard.

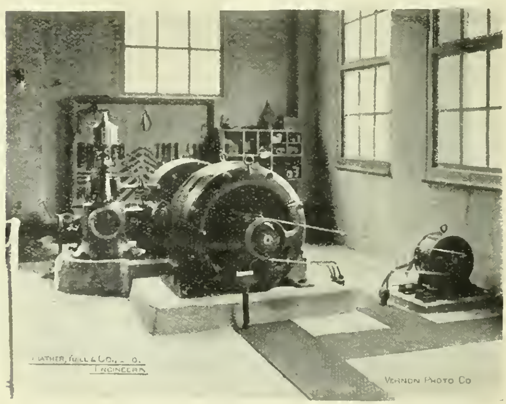
The water-driven unit is composed of a Pelton wheel operating under five hundred and fifty feet head, with Pelton oil pressure governor, direct connected to a one hundred kilowatt Canadian General Electric generator running at nine hundred revolutions per minute. The two hundred brake horsepower Diesel engine is by Carels Freres, of Ghent,

Carels-Diesel engine and Swedish generator.

Belgium, through Messrs. C. W. Stancliffe & Company, of Vancouver, and is directly connected to a one hundred and twenty-five kilowatt Swedish General Electric generator supplied by the General Supplies Limited, of Calgary. Both generators are three phase, sixty cycle, two thousand five hundred volts and are operated singly or in parallel. The switchboard of blue Vermont marble supplied by the Canadian General Electric Company, is composed of two generator and one feeder panels. All interior high voltage wires are of lead covered cable with G. & W. potheads.

The revenue from the electric plant for the last year was approximately eleven thousand dollars or over seven dollars per capita. A very considerable portion of this is due to the general use of fans and heating appliances. The system is entirely self-sustaining and is being extended to all agricultural districts within a radius of five miles, the ranchers being quick to seize the opportunity of improving their

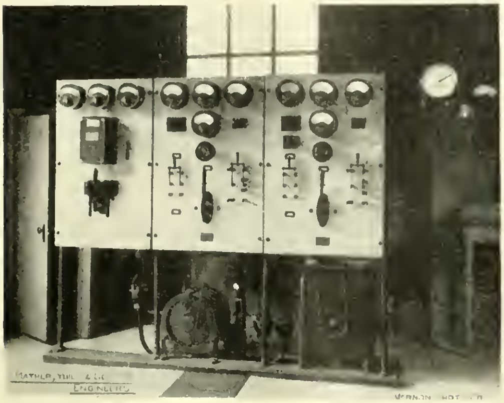
Municipal power house.—Armstrong, B. C.



Pelton water wheel and governor, Armstrong, B. C.

property and rendering home life more attractive to the younger generation.

The success of the installation is in a large measure due to Mr. J. M. Wright, the present and first mayor, and to Mr. T. K. Smith, chairman of the water and light committee. The superintendent of the electric light system is Mr. George



Switchboard, C. G. E. type, Armstrong, B. C.

Macnaughton. The consulting engineers for the city are Messrs. Mather, Yuill & Company, Limited, of Vancouver.

The domestic water supply of Armstrong is notably free from contamination, a fact that strangers in the city are not allowed to lose sight of. No irrigation is required in this district which is situated just north of the dry belt, the winter snows providing sufficient moisture.

Maritime Provinces Active

The city of Halifax is installing ornamental luminous magnetite lamps on some of the principal business streets. Orders have been placed with the Canadian General Electric Company covering fifty 6.6 ampere series type, with ornamental brackets and necessary station equipment. The Public Improvement League of Halifax had Mr. W. F. Winkeley of the G. E. Company give an illustrated lecture on lighting at a recent meeting of the city merchants.

Halifax, N.S.

The Public Utilities Commission have been meeting recently considering Halifax tramway matters. The Tramways Employees Union applied for an order compelling the company to equip cars with air brakes. No decision has yet been given. The company applied for permission to issue $600,000 more stock. This has been refused by the Commission who maintain that not enough information had been furnished by the company as to what the money is required for. This extra information is being furnished by the company.

Truro, N.S.

The new corporation lighting plant will be in operation by November 15th and when completed will be most modern in every way. The principal streets will be lighted with ornamental iron standards carrying each three sixty watt lamps enclosed in 12-inch Alba globes. The wiring is carried underground in lead covered cable. Wheeler fixtures with radial wave reflectors will be used on the poles for side and back streets. Four hundred of these and fifty standards will be used. Three 10 kw., 4 ampere transformers are being installed, the ornamental lighting being operated from series circuits through S.L. current transformers. The power plant is being installed in the town pumping building and will consist of a 50 kv.a. 2,200 volts, 3-phase, 50-cycle generator, with exciter, direct connected to a Robb vertical single cylinder engine operating at 400 r.p.m. The plant was designed and is being installed by Mr. C. McDonell, town engineer, the apparatus being supplied by the Canadian General Electric Company.

Broughton, N.S.

The Cape Breton Coal, Iron & Railway Company are planning on installing an electrical equipment in their collieries. Two units of 1,000 kw. capacity each will be installed. Mr. C. J. Coll is the general manager.

Amherst, N.S.

The Canada Electric Company have now in operation their new 1,000 kw. Curtis turbine. They have also completed a new transmission line from their Chignecto power house to sub-station at Amherst. This line is built for 22,000 volts, using number 2 hard drawn copper cable. A new equipment of transformers is being installed in the sub-station. The old equipment, which has become too small, is being moved to Joggins Mines to supply current to the pumps and hoists of the Maritime Coal, Railway & Power Company in their mines. The electrical equipment was furnished by the C. G. E. Company. Mr. M. V. Sammett of Montreal is the consulting engineer.

Sackville, N.B.

Negotiations are being carried on between the corporation of Sackville and the Eastern Electrical & Development Company whereby the town hopes to acquire the light and power plant of the company. The company is asking $65,000 for their plant and franchise.

New Glasgaw, N.S.

Many favorable comments are heard regarding the lighting of the Eastern Car Company's new plant. The building is 1,400 ft. x 1,000 ft. and is lighted by 100 C. G. E. flame arc lamps. These lamps operate separately on 110 volt, 60-cycle multiple circuits and are spaced one hundred feet apart and suspended 28 ft. from floors. Opal inner and clear outer globes are used and with white carbons the lighting of the building is practically daylight. Mr. F. W. Snyder the car company's electrical engineer designed the lighting system. The Canadian Car & Foundry Company, Amherst, N.S., have installed the same style in their new steel car building plant, their building being similar in construction to the Eastern Car Company's building.

Charlottetown, P.E.I.

The Charlottetown Light and Power Company have sold out their business to the Maritime Trust Company and a new company, The Charlottetown Electric Company, has been formed. The city council had employed Mr. C. H. Wright, of Halifax, as consulting engineer and had made an offer of $96,000 for the entire plant, this being at the rate of 123 per share. The ratepayers at a public meeting turned this proposition down, however, and the company then sold out to the Maritime Trust Company at a price of 120. The new company is issuing bonds and $150,000 of common stock. It would look as if the city of Charlottetown had lost a very good opportunity.

Stellerton, N.S.

The Acadia Coal Company are installing an electric pumping equipment in their Vale colliery and are building an 11,000 volt transmission line from Stellerton power house to operate same. The line is eight miles long, number 6 hard drawn bare copper wire being used. Transformers at both ends of line are three-phase units of 250 kv.a. capacity. The

(Continued on page 55)

Importance of Correct Factory Lighting

By M. H. Flexner and A. O. Dicker

The aim of this paper is to bring out a few of the most important factors entering into the design or re-design of a lighting system for the factory. It is somewhat discouraging to the illuminating engineer to read article after article dealing with the methods used to raise the sanitary condition of the factory and when all has been read he asks himself "What about the lighting?" Ventilation, cleanliness, devices of safe operation of machines, rest rooms for employees are all discussed, but little or no attention is given the lighting. It is the hope of the authors that this paper will emphasize the fact that factory lighting is a subject dealing directly with sanitation and that it should be considered as such. Why is the lighting important, and whom does it affect? Does it mean a benefit for the central station only, or is it of equal benefit and importance to employer and employee? It seems just as reasonable to ask why should a factory be ventilated or why should it ever be cleaned up. The owner or manager would immediately say: "If I do not ventilate the work rooms the operators will become dull and lose interest in their work." Regarding his lighting conditions he knows naught and his answer to a question relative to his lighting condition, would very likely show that he never gave it much thought. This is just the man who needs some information regarding lighting. He does not realize that just as many of the headaches are caused by poor lighting in factories as there are from poor ventilation. This is not intended to belittle the importance of good ventilation, but is only mentioned to emphasize the fact that general improvement of condition does not end when a factory has been properly ventilated or properly cleaned. It does not end until the lighting as well as these have been considered. One is just as important as the other, since injury to the eye from poor lighting causes suffering equal to or even greater than the sickness caused from poor ventilation. In considering such vital subjects this country seems to be far in the rear of countries on the other side. We're behind the times, so to speak, and have not kept pace with France, England and other European countries, who are protecting their workmen, along these lines.

In 1912 the French Government appointed a Committee on Hygienic Aspects of Illumination, composed of prominent physiologists, oculists, engineers, physicists, and inspectors of factories. The main object of this committee are:

(a) To study, from the standpoint of general health and its effects on vision, the various methods of artificial lighting now used.

(b) To determine the composition and quality, from a hygienic standpoint, of the different combustible illuminants, and to examine the effect of prejudicial gases and the amount of heat developed thereby.

(c) To fix a certain amount of artificial illumination to the normal requirements of vision.

(d) To study the most practical methods of measuring illumination.

(e) To formulate recommendations governing the best means of applying customary methods of lighting to the chief varieties of industrial operations.

(f) To present to the Ministry a report on the subject of short sight and impairment of vision, and on the best methods of guarding against the cause of myopia.

It is the result of the investigations of such committees that awaken the mind of the manufacturer to the necessity of providing good lighting.

The first question that might be asked is: What is good illumination, or what is practical illumination? Can we spot a unit or cluster here or there, put a drop light over the working places in a slip-shod sort of maner and expect to be satisfied with the results; or, is it a matter of knowing what to expect from each means of illumination and its corresponding reflector and to fit in these units to meet the conditions in the factory? Our common sense dictates that it is the latter. Our experience teaches us that the problems involved are often difficult of solution and that we must have definite ideas about correct illumination before we attempt to accomplish satisfactory results.

One authority defines good lighting as any system which does not attract attention to the means of illumination, or cause one to wonder how the illumination was obtained. An analysis of this yields the following requirements for good lighting:

First, that sources of high intensity must not be in the field of ordinary vision; second, that the amount of light be sufficient for the work to be done; third, that the distribution of light be uniform or as nearly so as possible, and fourth, that the color be pleasing to the eye. By adhering to these principles, we will not go far wrong in laying out lighting installations, whether for factory or for home, being assured of good illumination.

Good Light Means Good Work

The value of good illumination should not be under-estimated. Some are contented to travel along in the old time worn ruts and to leave well enough alone. Many believe that as long as there is light, whether good or bad, the question of lighting is settled, and that the results obtained are as good as any light could produce. This is the wrong idea, but nevertheless it is entertained by many managers and officials of factories under whose jurisdiction the question of lighting comes; however, they must realize sooner or later the value of better operating conditions, produced by good lighting. To do work, light is necessary; with a little light, a little work can be done and with more light more work can be accomplished. This is very evident, and it is easily seen that no matter how a shop is lighted, if it can be better lighted, better or more work must result in a definite per cent. increase in efficiency of the workman.

What if our Mr. Official had to go home to a dimly lighted dining room? How would he like to read a paper which necessitated straining his eyes, or shave in little or no light, with his face very near the mirror and his eyes fixed in a staring position. It would not be very comfortable and he could hardly give himself much of a shave; yet under these conditions he expects his men to work, to turn out good work, and make his factory an efficient one.

There are such things as good and bad lighting installations, and to the progressive official the best should not be too good for his men. However, the initial cost is given first consideration and is the one stone that lies in the path of all changes, and therefore we can but sum up the reasons why it is worth every cent that is asked in making a lighting installation a good and efficient one.

Statistics have shown that, as the result of better illumination and a decreased strain on the eye, the physical condition of the workmen is better, they are better satisfied, imperfections in the work have been materially decreased and the factory output increased from 8 to 15 per cent.

Not only is the general physical condition of the workman improved by better lighting but his liability to accident is greatly decreased. Recently published statistics show that during those months of the year in which artificial lighting

* Read before the I. E. S. Convention, Pittsburgh.

must be used, there occurs a greater number of accidents than in the light months. The saving made by good lighting in this line alone will often more than repay the extra cost of installing and maintaining the lighting system. It has been said that a man who is obliged to keep one eye on the danger points of a machine has only one eye left to operate it. This is unquestionably true and consequently a machine must be made absolutely safe. The factory manager usually tries to accomplish this by putting a guard rail around the danger points or else enclosing them entirely. This seems about as reasonable as putting a rail around a hole in a street without placing a lantern on it. Protected machines still cause accidents and will continue to do so until the proper light is provided and the danger point brought well into view. Accidents are becoming more expensive each year and disregarding all humanitarian arguments an owner can no longer neglect to protect the operators from accidents. Good light is the most effective protection that can be provided and only carelessness on the part of the employee will incur accident under these conditions. "It costs us a lot of money, but it has paid for itself in less than a year" said one manufacturer. What more can an owner want? Certain courts have held that failure to illuminate danger points constitutes "contributory negligence." Germany, Austria, Holland and France, realizing the importance of good lighting conditions, have included lighting in their codes for factory inspection of health and safety.

In the installation one must take into account the position of the machines, the work that is done, the location of posts, the windows, and in fact every condition which may in some way cause deep shadows and bad illumination. The scope of this paper does not allow us to enter into any detailed account of layouts. As stated in the introduction, we are only attempting to emphasize the necessity and advantage of better factory lighting.

Good Lighting An Easy Matter

Good factory lighting is not beyond reach; it is not something that one can only wish for. It is a material thing and may be had for the asking.

A great many bad installations can be made good ones by two inexpensive methods; either re-locating the units and the addition of proper reflectors, or in some cases by replacing existing units with some of the modern efficient type now on the market. It is not hard to show that the new system will, within a given time, pay for itself, and in a great many cases save money over the operating and maintenance expenses of the old system.

Assume that the owner of a factory depends solely upon the profits of the work his employees turn out. An equation expressing output must involve the personal equation of the men and there must be a certain personal efficiency of each man under every condition in which he works. If a high priced man is placed under poor working conditions his work will be no better than the low priced man under good conditions. A manufacturer will usually buy a labor saving device or a machine with which his workers can turn out more or better work, and he will supply his employees with tools of the highest grade steel and have men to keep these tools in the very best condition; but he often absolutely ignores the personal efficiency of the operator and the conditions under which he must work. He does not usually see all the methods of making the man as perfect as his tools. In other words, more time and thought is given to the tools than the operator. What good is a perfect tool or machine if the operator can hardly see what he is doing with it? This sounds ridiculous, of course, but it is true of many a factory to-day. For instance, a manufacturer purchased a certain machine at a cost of $18,000.00 and paid a high priced man of long experience to operate it. Yet this owner could not see his way clear to spend $19.00 in order that this high priced operator would not have to take the product twenty feet away to the window to caliper it. This shows how little the owner considered the personal efficiency of his men.

The cost of illumination as compared with an operator's salary is very small and insignificant; in fact, so small that the manufacturer can not see it at all. The following data, taken as average conditions, shows this.

If a 100 watt lamp is assumed for each man and that it burns $3\frac{1}{2}$ hours per day for 300 days, the following is derived:

Cost of lamp (Commonwealth Edison Co. renewal)		$0.00
Cost of reflector		1.00
Cost of wiring per outlet		4.00
Total first cost		$5.00
Interest on investment 6 per cent.	$0.30	
Depreciation at 12½ per cent.	0.70	$1.00
Power at 5c.		5.00
Cleaning at 3c. per mo.		0.36
Renewal of lamps		0.00
Total		$6.36

Wages for 10 hours a day, 300 days, may be assumed to be $1,000.00. Thus the ratio of the cost of furnishing illumination to a man under the above conditions would be (overhead expense not included), $\frac{6.36}{1,000}$, or 0.636 per cent.

The following mathematical deduction shows what good lighting would mean to a factory upon the installation of such a system. Taking an area of 30,000 square feet with an average of 0.75 watt per square foot, a connected load of 22,500 watts would result. Figuring the installation with 250 watt units an estimate of the first cost is surprisingly low:

90 250-watt outlets at $3.50	$315.00
90 fixtures at $1.25	112.50
90 reflectors at $1.00	90.00
90 lamps (Commonwealth Edison Co. renewal)	0.00
Total	$517.50

Let it be supposed that this factory turns out a yearly business of $250,000 and that 33 1-3 per cent., or $83,333.33 of this business is done under artificial light. Assuming a conservatively 5 per cent. increase in output as the benefit due to good lighting, the business is then increased $4,166.67. If there is a profit of 20 per cent. on this output a credit of $883.33 is derived, which is considerably more than the installation cost.

As further proof of the low installing and operating costs of good lighting the following data are submitted from a table compiled from actual figures on three trial installations in a large factory with lamp prices, etc., revised so as to be up-to-date.

100-Watt Tungsten Lamp

30 reflectors at 92c.	$27.60
Wiring at $3.22 per outlet	96.60
30 lamps at 0.72	21.60
Total	$145.80
Interest on investment at 6 per cent.	$8.75
Depreciation on reflectors at 12½ per cent.	3.45
Depreciation on wiring, etc. at 5 per cent.	4.83
Renewals at 30 × 900/1000 hrs. × 0.621	16.77
Energy 3000 × 900 hrs. × 1.1c.	29.70
Labor (cleaning 30 × 0.63 × 20 c.)	3.78
Total annual cost	$67.28

These figures are derived on the assumption that good factory lighting will necessitate a 100-watt lamp for 100 square feet of working area required by an ordinary workman. With these assumptions the following information has been tabulated:

Total working hours 300 × 10	3000 hours	
Total lighting hours 300 × 3 1-3	1000 hours	
Average cost of labor per hour	35 cents	
Labor—		
3000 hours at 35c.		$1,050.00
Light—		
Cost of 100-watt tungsten lamp (Commonwealth Edison Co. renewal)		$0.00
Cost of metal reflector (trade price)		1.00
Average cost of wiring per outlet		3.50
Initial investment per outlet		$4.50
Interest at 6 per cent. on $4.50	0.27	
Depreciation at 12½ per cent. on $4.50	0.56	0.83
Cleaning 12 mo. at 3c.	0.36	
Lamp Renewals (Maintenance)	0.00	0.36
Energy 100 kw.h. at 5c.		5.00
Annual operation cost		6.19
Annual wages for one man		$1,050.00
Cost of light in per cent. of wages		.59

When reduced to cost per hour based on 3,000 working hours per year, one finds:

Labor per hour	$0.35
Light per hour	0.00619
Cost of light per day	0.02063
Cost of labor per day	3.50

These figures go to show that the cost of good lighting is a very small portion of the cost for a man's time; in fact, if good lighting would save five minutes of a man's time per day a material gain would be experienced.

By following this form, any local conditions causing different prices than those given can be substituted so that a comparative figure can be obtained for any particular locality.

The cost of maintenance of tungsten lamps and reflectors is stated as follows in Vol. 1 of the 1911 Proceedings of the National Electric Light Association.

	Per Cent.
Renewals of lamps	75
Renewals of broken reflectors	3
Labor making renewals	0
Changing reflectors for washing	16
Labor for washing reflectors	2
Additional indirect charges	2
	100

This data is from experience with an installation of between 7,000 and 8,000 lamps and reflectors.

With the available units, it is impossible to pick out one lighting unit and say that it can be used for all conditions. There is no one cure for all evils. Individual conditions enter into the problem and the resulting unit must be best for the conditions presented. The most important qualifications are the following: Efficiency; color; quality, arrangement of machines—processes; adaptability; special architectural features; and available hanging height.

The best unit to use will be the one that best fulfills these requirements. Each light source, whether gas arc, individual gas, electric incandescent, arc or vapor lamps, has its definite field in factory lighting. Usually where one should be used the others will be less satisfactory. It is hard to convince the owner that the cheapest is not the best, for he usually wants light only, and often will not pay for the necessary equipment to produce illumination. The problem of which one to use depends upon the class of work to be done under it, as each lamp has certain characteristics that argue for and against its use.

The last few years have brought great developments in the arc lamp. The flame arc of long life, furnishes a light source of high candle-power and low maintenance cost. When the white light-giving carbons are used the light emitted is of good but rather variable color. This lamp should never be used in the normal range of vision. It is best adapted to factories with high ceilings, as the intrinsic brilliancy of this light source is 5,000 candle-power per square inch.

There has been considerable talk about the harmful ultra-violet rays emitted from arc lamps. These rays are no doubt given off to a considerable extent, but they are lost in the inner globe. Therefore this characteristic should not be an argument against the arc lamp. The greatest objection to this light source is its steadiness, and for fine accurate work a more steady unit might better be used.

The mercury-vapor lamps are particularly well adapted to certain kinds of manufacturing. The peculiar color together with the high visual acuity renders them very useful. A large clothing manufacturing concern has recently replaced enclosed arcs with vapor lamps in pressing rooms. It is remarkable the way scorching can be detected under this lamp while if a tungsten lamp is used the scorch is not so noticeable. The vapor lamp has met with decided approval in this kind of work. This goes to show that the unit used should depend entirely upon the work to be done.

Keep Lamps Clean

In installations where the tungsten lamp is the source of light, too much emphasis cannot be put on the subject of cleaning. The manufacturer would not allow his operators to leave their machines at night without cleaning them; the floors are cleaned and each morning the factory is found in tip-top shape. Why? So that the work may begin under the best conditions, all working toward an increase of output. In other words, everything but the lighting equipment is systematically taken care of. The owner knows that the time and money spent in cleaning a machine is well spent, and yet that which has a greater effect on the efficiency of the operator is left to accumulate dirt from day to day and in many factories from month to month.

In general, it is best to have the light source as high as possible above the working plane. If it is out of reach of the worker, he cannot handle it and thus it will be free of a coating of oil or other dirt. Truly enough, certain machines require drop cords in setting up the work or changing the dies, but few machines actually need drop cords during their operation. One big railroad shop in Chicago has adopted Cooper-Hewitt lamps for general lighting and drop cords are checked as any other tool. In this way they are taken care of and are not used except when necessary. It has been our experience that the worker will use a drop cord as long as he has one in front of him.

The first move for efficient lighting is general illumination, where possible, doing away with the drop cord or as above stated, making the drop cord a working tool.

There are many combinations of efficient lighting systems; in fact, it is a subject of its own, so that we will not attempt a discussion.

Realizing the general disregard of good lighting as a necessary and important part of the factory equipment, and not overlooking the attractive lighting load of this class of service the Commonwealth Edison Company of Chicago decided to make a proposition covering lighting installations for factories.

As has been stated, the first cost of the installation is

too often the only obstacle, and therefore this company decided that the first way to make such a proposition attractive was to do away with the first cost. To insure most efficient operation the company includes in this proposition the cleaning and renewing of all fixtures and lamps.

The Commonwealth Edison Company's proposition is as follows:

The customer is asked to sign a contract for a period of twenty-four consecutive months. After the expiration of this period, the wiring and fixtures become the property of the consumer.

The charges for this service are made up on the following basis: rental charge, maintenance charge and electricity charge.

Rental Charge.—The rental charge is twenty-five cents per fixture per month, allowing the consumer to use either 100, 150 or 250-watt units in each fixture. At the end of the two year period this equipment becomes the property of the consumer and this charge is discontinued.

Maintenance Charge.—The consumer pays the company twenty-five cents per fixture per month, except during the months of June, July and August. At the end of the two year period, the consumer may elect to discontinue paying this charge and take care of this equipment himself.

Electricity Charge.—For this service the consumer pays our regular schedule. A rate which is ten cents net per kilowatt hour for the first thirty hours use of the maximum demand per month and five cents net per kilowatt hour for all energy used in excess of this amount.

The fixture supplied under this contract is one that was especially designed for this class of service. It consists of a shallow reflector with a collar containing a lock socket; the conduit serves as a stem. The reflector is so designed that the filament does not extend below the bottom of the reflector. Photometric curves show extensive characteristics. The idea throughout was to make a reflector that was efficient, plain, and easily cleaned.

The Commonwealth Edison Company confidently expect to install 10,000 of these fixtures within the next year, and a report of the first few months gives reason for the confidence expressed.

In summing up we believe that the campaign for good factory lighting has just begun and that the best argument in favor of better illumination is a statement showing the benefits derived from an efficient lighting system and the experiences of others.

Even a hasty reconsideration of the arguments presented in this paper demonstrates the tremendous scope and possibilities along this line. There is no longer any excuse for poor lighting; the necessity, the practicability, and the economy of good illumination have been demonstrated beyond question and if the strides in this direction which have been made in the recent past may be taken as an index of those which will be made in the future, there is no doubt that very soon the time worn phrase "a badly lighted shop" will have disappeared from the vocabulary of those connected with the lighting industry.

We believe that if a fair and broad-minded manufacturer will but figure out in a common sense way the merits and necessity of good illumination, he will be converted to its use in a short time. If his own figures do not satisfy him, let him consult those who have been far-sighted enough to go ahead with his better sense dictation and be shown, if necessary, the truths of the above assertions. He will realize sooner or later the needs of his men—better atmosphere, lighter and cleaner shops, and proper illumination.

The Council of St. Hyacinthe, P.Q., has passed a by-law granting to C. McCuaig & Company, Montreal, a franchise to supply the district with electric light and power.

Personal

Mr. C. R. Hosmer has been elected president of the West Kootenay Power & Light Company, succeeding the late Mr. W. M. Doull.

Mr. Guy H. Morton, manager of the Calgary office of the Canadian Westinghouse Company, has been appointed lecturer in electrotechnics by the technical education committee of the Calgary Board of Education.

Mr. C. H. Tillett has been appointed in succession to Mr. R. A. Becker, resigned, supervisor of signals on the eastern lines of the Grand Trunk, having charge of interlocking plants, automatic signals, electric crossing bells, etc. His headquarters are in Montreal.

Montreal Notes

The Canadian Society of Civil Engineers, Montreal, have arranged for meetings of the electrical section on December 4th and March 19th, 1914. Mr. R. M. Wilson is chairman, and Mr. J. C. Smith vice-chairman of the section.

The Montreal Council have passed a by-law forbidding the erection of poles or lamp posts and the stringing of electric wires along or across public places without special permission of the city.

The City of Montreal have received tenders for the supply and erection of a 35 kw. generator, direct coupled to a steam engine. This is required for electric lighting purposes at the low level pumping station, Point St. Charles.

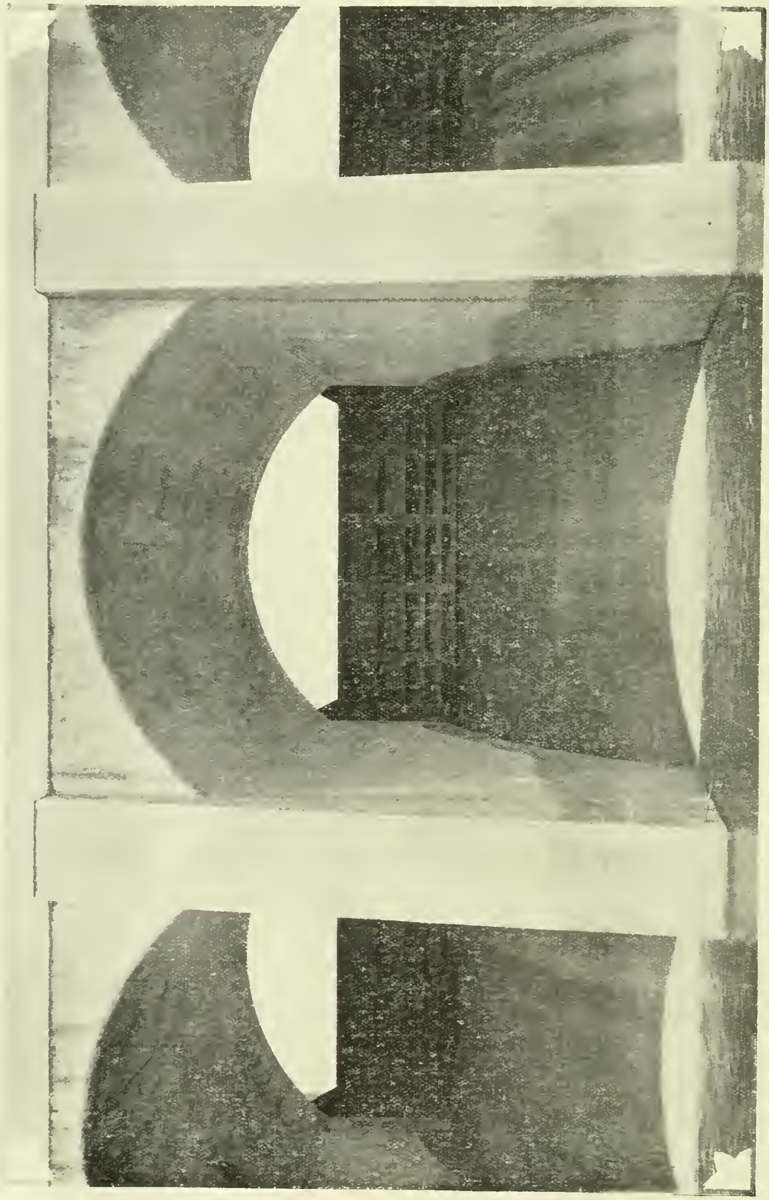
The Quebec Development Company, Limited, incorporated under a Federal charter, with a capital of $2,500,000, has for its objects the acquisition of water rights, the manufacture of electric machinery, the erection of plants and generating stations, and the building of underground subways. The head office is in Montreal, and it is understood that American capital is behind the project.

A deputation from Valleyfield headed by J. O. Mousseau, provincial member for Soulanges county, have had an interview in Montreal with the Minister of Lands in the Provincial Government, Hon. J. Allard, and requested that Valleyfield be allowed to use water power from the St. Lawrence, near Couteau, with a view to generating electricity.

The Fire Prevention Company of Canada, Limited, Montreal, have been awarded the contract to equip the Quebec Provincial Government buildings and the new Provincial library, now being built with the Reichel automatic fire alarm signal system, which is electrically operated.

The electrical station at No. 1 elevator of the Montreal Harbour Commissioners is now being re-organised consequent upon an addition to the storage capacity. Further equipment has been purchased, the Canadian Allis-Chalmers, Limited, supplying three 250 kw. oil-cooled transformers, stepping down the current from 2,500 volts to 550 volts. The Monarch Electric Company, St. Lambert, P.Q., secured the contract for the panel board, the high tension panels numbering eight and the low tension panels 17.

The Dominion Government recently commissioned Mr. Leo G. Denis to investigate the water power conditions along the projected line of the Hudson Bay Railway. Mr. Denis has just returned from his trip and was recently quoted as saying that the conditions found there were not such as would indicate the possibility of this railway ever being operated electrically. Mr. Denis advises us, however, that his meaning was misconstrued and that he made no such statement about the difficulty in the way of operating this railway by electricity as was ascribed to him.



Mississippi River power plant, Keokuk, Iowa—Showing completed spillways, with gates in closed position.

Montreal Tramways Improvements

As already stated in the Electrical News, the Montreal Tramways Company are engaged on a very extensive scheme of improvements, in order to meet the enormous expansion of traffic. At the beginning of the year the directors appropriated $3,750,000 for new equipment and renewals, in addition to large sums for maintenance. The programme, as mapped out, cannot be finished this season, but the company will have spent before the snow comes about $3,000,000 of the sum allocated.

Major Hutchison, the manager, states that the company have laid seven miles of new track, and have renewed twenty miles of track in the principal streets of the city, besides improvements scattered all over the 270 miles of the entire system. In the track that has been renewed they have replaced the rails of 87 pounds to the yard with steel rails weighing 116 pounds, and have laid these in solid concrete above crushed stone, with far more ties than were formerly used. The company now have a roadbed in the principal streets which is the equal of any in the world. Fifteen new intersections have been laid and 38 old ones renewed, and in every instance where possible the company have put in clearance curves so that cars can pass each other on the curves. When those now on order have been laid, these clearance curves alone will relieve the congestion on busy lines like Craig and Bleury by 50 per cent.

As to the rolling stock, Major Hutchison states that 100 more cars are in operation than at this time last year, making a total of 775 cars. This means an added carrying capacity of much more per 100 cars than the average, as all the new cars are heavy ones of very large capacity. These new cars have cost over $8,000 each. The company are now getting new cars delivered at the rate of four per week, and they are all being put into service as soon as they arrive. There are yet 250 cars on order. The large repair shops at Youville enable the company to overhaul the cars quickly; each car is renovated once a year.

Experiments have lately been made with a view to changing the color of the cars. It has been found that the light yellow paint becomes shabby, especially on the steel cars, which seem to rust through and discolor the paint. It is likely that the color of all the cars will be changed to green with cream and gold trimming. The color of the suburban cars has already been changed to orange which enables them to be easily distinguished. Another inovation is that all the new cars have ventilators which are always open and so designed as to give ventilation without draught.

The company are at present working out the details of a plan which will result in a perfected traction system especially in the outlying districts. The completed extension will cover a wide area and will further relieve the central congestion and inaugurate a rapid and frequent service to the most remote districts.

Ottawa Street Railway Extensions

An extension of the Ottawa Electric Railway was opened last week to Ottawa South, thus adding about three miles of tracks to the present system. The new line extends from the former terminus at the Exhibition grounds on Bank street.

The opening of the new line was made the occasion for a little ceremony in which all the members of the city council, a committee of prominent residents of Ottawa South, and some of the directors and officials of the O. E. R. took part. Two new cars took the party from the City Hall over the new line, which goes over the new Bank street bridge, to Sunnyside avenue, then down Sunnyside, Seneca, and Grove to Bank street, at a point within less than a quarter of a mile of the city limit.

A luncheon was served on Dr. Graham's lawn, provided by some of the residents in Ottawa South, at which toasts were proposed by ex-mayor Charles Hopewell. To the toasts of the Ottowa Electric Railway, Mr. Thomas Ahearn, President of the company, and Mr. Warren Y. Soper, Vice-President, replied. Mr. Soper referred to the growth of the Ottawa Street Railway and recalled the time when Mr. Ahearn and himself drove the first cars on Bank street as far as the Exhibition grounds 23 years ago. At that time Ottawa had a population of 35,000 and less than 100,000 people were carried on the cars in that year. Now, he said, the city's population is 100,000 and over 25,000,000 passengers will be carried this year.

The construction of the new line cost about $50,000. Other extensions on Preston street and in New Edinburgh will be opened early next month.

Artistic Passenger Station

The British Columbia Electric Railway Company has just received tenders for the construction of a passenger station at the terminus of the Lulu Island Railway at Vancouver. The Lulu Island Railway is owned by the Canadian Pacific Railway Company, and is operated by the B. C. Electric under a long term lease. It extends from Vancouver across Lulu Island to Steveston, with a branch from Eburne to New Westminster. The section of the line between Vancouver and Eburne passes through a section which is a well-settled suburban district, from which arises commutation traffic, trains being run over this portion of the route during the rush hours at intervals of fifteen minutes. At the present time the Vancouver terminus of the Lulu Island Railway is located on the north side of False Creek, the

B.C.E.R. Lulu Island passenger station.

station being reached by passing over a long trestle bridge. Because of the increase of navigation in False Creek the draw span of this bridge is frequently opened, thus delaying traffic. The station itself is not situated to the best advantage for transfer to the city lines inasmuch as these lines, with a single exception, now run over the Granville street bridge, which at this point has an elevation of over thirty feet above the level of the interurban station.

The new Lulu Island terminal is located on the south side of False Creek, and on the west side of Granville street bridge. The level of the station is the same as that of the bridge proper, of which it will practically form a part. With the station in its new location, the interruptions of the service caused by the opening of the draw span of the False Creek bridge will be avoided and transfer from the interurban lines to several branches of the city system can be conveniently made. The station is located on the foreshore, thus necessitating a pile and timber construction for its support. This platform is 198 by 140 feet in size, and is now completed. The layout provides for the location of the station a short distance back from the line of the Granville street bridge. The interurban passenger trains will leave the Lulu Island railway track at Third avenue. Along this

street a double track line will be constructed to the station platform. At the rear of the station five tracks are provided for, accommodation of the regular trains and storage space for special cars, etc.

The station will be of the ornamental type, the plans calling for an attractive frontage in half timber and steel, with a clock tower over the central portion of the roof. The entire station will be 115 feet long, and 29 feet wide. The central 25 feet of the building is an open passage way in order to provide prompt and convenient facilities for the transfer of passengers from the interurban to the city lines. To the north of the passageway is located the main waiting room which is 29 feet square. This room will be of an ornamental type, having beamed ceiling, etc. Adjoining this room will be the ladies' waiting room and the news stand. The section of the building to the south of the passageway will be used for a general ticket office and the offices of the staff connected with the Lulu Island division. The building will be fitted throughout in a tasteful manner, the architectural appearance of the Granville street frontage being particularly attractive by reason of the heavy timber brackets supporting the roof and the ornamental beam work in connection with the stucco.

While definite figures are not yet available, the estimated cost of the new terminal will probably be in the neighborhood of $40,000.

Metallic Sand Spout

Electric traction officials and car builders are manifesting considerable interest in a spout known as the J-M Metallic Sand Spout which it is claimed will outwear any other form of spout on the market. This device consists of a remarkably strong metal ribbon wound spirally, the edges being crimped, or turned in, during the winding, forming a continuous interlocking metal spout that can be bent to the desired curve without fear of fracture. The spout withstands a crushing strain of 300 lbs. to each four turns of its spirals, and can not break square, flatten or bend beyond the give of its interlocking metal spirals. Therefore leaks are impossible —a very common occurrence with ordinary coiled wire spouts which readily kink and leave an opening that gradually enlarges, permitting the sand to leak out. Ordinary spouts, if accidentally caught, unwind with little resistance, and are likely to whip around and injure anyone standing close to the car. As the J-M spout withstands a pulling strain of 1,000 to 3,000 lbs. it can not unwind if it strikes an obstruction.

This spout is supplied either in stiff or flexible form so that it can be set rigidly in any position or adjusted to sand the curves. It is furnished with plain couplings or with couplings for either DeWitt or Ridlon sand baxes. Standard diameter 1⅝ inches; lengths 30 inches and 36 inches. Special sizes made to order.

Ontario Municipal Railways

Reports have been prepared by the engineering department of the Hydro-electric Power Commission of Ontario on the cost of constructing and operating radial lines from Toronto to Uxbridge on the north and to Whitby on the east. The general scheme embraces 71 miles of line which is calculated to cost approximately $2,500,000, or at a rate of $35,000 per mile. This mileage would connect Toronto with Markham (16 miles); with Uxbridge (20 miles); Markham with Port Perry (28 miles); Brooklin with Whitby (7 miles). Brooklin is a point on the Markham-Port Perry section. The engineers have provided, in the estimate, for a service not less frequent than every hour and three-quarters on every section of the line and as frequent as every fifteen minutes in the vicinity of Toronto. The probable operating revenue for the whole line is placed at $450,000. operating expenses $240,000, interest and sinking fund $155,000, leaving a surplus of approximately $55,000. Two other schemes were also suggested and figures given for a system covering a more restricted area.

Trade Publications

Compressors—Bulletin No. 34 T, issued by the Chicago Pneumatic Tool Company, descriptive of class M Corliss type steam driven compressors.

Circuit Breakers—Circular No. 1205, issued by the Detail and Supply Department of the Canadian Westinghouse Company, describing and illustrating carbon circuit breakers.

Condulets.—The Crouse-Hinds Company have just issued a new bulletin covering condulet types for railway requirements; also one covering radial switches and one covering roundhouse reflectors.

Glassware—Catalogue issued by the Elkins Glass Company, Pittsburgh. This catalogue contains a description with illustrations of the new "Vesta" glass, a product now being placed on the market by this company.

Translux—A catalogue issued by the Pittsburgh Lamp, Brass and Glass Company, describing their latest designs of bowl, semi-bowl, flared and ornamental ball and bowl types of glassware. The catalogue is well illustrated.

Wire Reels—A pamphlet issued by Mathias Klein and Sons, Chicago, manufacturers of lineman's and construction tools, describes a combined take-up and pay-out wire reel in a number of different designs for electric light, telephone and telegraph work.

Single-Phase Converters—Bulletin number 103 issued by the Wagner Electric Manufacturing Company, St. Louis, describing single-phase converters for changing single-phase to direct current required in such work as moving picture machines, battery charging, X-ray work, etc.

Polyphase Motors—Bulletin 160, issued by the Bell Electric Motor Company, describing their compensator type of polyphase motors. This is claimed to be the most advanced type of polyphase motor ever produced; highest in both power-factor and efficiency; no starting box or compensator required; entirely automatic in starting.

D.C. Motors—Bulletin number 150 describing direct current motors of inner pole design manufactured by the Bell Electric Motor Company, Garwood, N.J. These motors are of new and recent design. The use of the inner or commutating poles represents such marked improvement over the old design that they are claimed to be worth the extra cost of building.

Lighting and Wiring Devices—General catalogue No. 12, issued by George Cutter Company, South Bend, Ind. This is a 135 page book so classified and divided into schedules that all devices of a more general nature are listed together and it is possible to locate easily the piece of apparatus desired. The equipment covers street lighting equipments, panel boards, switchboards, wiring specialties, etc., etc.

Siemens Publications—Meters—a booklet containing instructions on the use of meters, with diagram of connections. A.C. Meters—a booklet describing alternating current watt-hour meters, with instructions as to their use. Polyphase Meters—a description of polyphase watt-hour meters for 3-phase current, including instructions for their use. G5 Meters —describing watt-hour meters for direct or alternating current, including instructions for use and diagram of connections. A booklet entitled Electricity Meters which is a general description of the various types manufactured by the Siemens Company; also a sheet entitled the Siemens Combined Unit and Demand Meters.

Illumination

Principles of Illumination

II.. Refraction

Rays of light travel in a straight line as long as the medium through which they are moving remains uniform and unchanged, but the slightest change in density or material causes the rays to change their course. If the second medium is uniform the rays continue to travel in a straight line in the new direction. For example, if a piece of glass is interposed in the path of a ray of light, RO, Fig. 1, the ray is caused to swing through a certain angle at the surface separating the two media, and passes out as OR_1 where the angle ROX is greater than the angle R_1OX_1. If the surfaces of the glass are parallel the ray will turn back to its original direction as it again enters the air, Fig. 2, but its path, though now parallel to its original path, has however been displaced as shown, the amount of displacement plainly depending on the thickness of the glass plate. If the sides of the glass are not parallel but are more or less prismatic in shape the phenomenon shown in Fig. 3 results. It will be seen, therefore, that with a varied arrangement of different shaped pieces of glass a very varied distribution of light is possible. This change of direction is generally described as a turning towards the normal, or perpendicular, to the common surface.

In general, the ray turns toward the normal if it is entering a more dense medium, and from the normal if it is entering a less dense medium than it is leaving. This is the only law that can be said to govern refraction, as the amount of the refraction varies with other properties of the substance as well as with its density.

Cutters of glass, precious stones, etc., make use of this

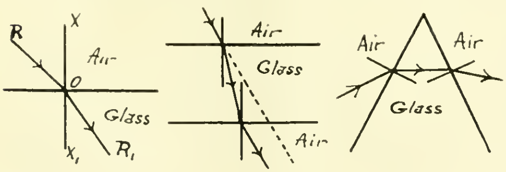


Fig. 1 Fig. 2 Fig. 3

property of refraction to obtain a sparkling effect and indeed the high monetary value of diamonds is the result largely of the property diamonds possess of refracting light through a very large angle. The diamond cutter by a clever multiplication of surfaces is thus able to produce refraction and internal reflection to such a degree that the diamond actually becomes a small ball of light and sends out rays in almost every direction.

Owing to difficulties met in manufacturing perfect reflectors, glass manufacturers have taken advantage of the property of refraction in directing and distributing rays of light. This product is known as diffusing glassware, the surfaces of which vary in construction from a combination of prismatic shapes (similar to that shown in Fig. 3) to a simple ground glass where the little unevenness, though too small to be perceptible to the eye, are yet sufficient to cause the necessary refraction.

Electric Train Lighting

What is claimed to be a very efficient system of train lighting is being placed on the Canadian market by Vickers Limited. This system, known as the Vickers Single Battery System, is self-regulating and automatic and is generally conceded to have attained as near to the ideal in electric train lighting as is practically possible without sacrificing simplicity and reliability in operation.

The mechanism of the equipment constituting this system is simple, strong and permanent, with very slight depreciation from wear. The equipment is claimed to contain fewer parts and to be less complex in its operation than any other system of carriage lighting, etc., and is entirely devoid of motor-driven regulating devices or intricate voltage relay controlling coils, which have been found far too delicate and complicated to properly perform the functions required of them. The regulating apparatus is, for convenience, carried from the carriage underframe, completely encased and protected from dust and dirt; there is no necessity to encroach upon the space inside the car. A dynamo is placed beneath the carriage and so adjusted that at a speed of, say, 10/15 m.p.h. it feeds the lamps direct, any excess current being stored in the battery for use when the train is stationary. The dynamo, which derives its power from the carriage axle, is automatically switched into circuit by the cut-out at the desired train speed, i.e., when it is generating an e.m.f. just in excess of that of the battery, the pressure being so controlled that at all speeds the current supplied to the lamps is uniform; the latter are prevented from receiving more than 24 volts by the resistance interposed in the circuit. When the car is at rest, and the cut-out has switched the dynamo out of circuit, the lights are supplied at 24 volts by the storage battery. Suitable provision is made in the dynamo for maintaining the correct polarity of the current for charging the battery whatever the direction of armature rotation.

The distinctive features in this system are the means employed for controlling the dynamo output and lamp voltage at all speeds, so that they shall always remain normal.

In the first case, this is accomplished by the use of a solenoid that operates when the dynamo is generating, and, with suitable mechanism, throws resistance in and out of the field circuit of the dynamo as the speed increases or diminishes. In the second case, when the dynamo is charging the battery its electromotive force rises; therefore, without some method of control the village would be come too high on the lamps, but in this system it is kept constant by means of a variable resistance in the lamp circuit. In order to preserve the battery and prevent an excessive charging current, the regulator operates to reduce the current to the normal charging rate when the lamps are turned off, all these operations being automatic.

For the protection of the batteries from overcharging,

a stop-charge switch is fitted on the regulator-controller. When closed by high charging voltage, it causes additional resistance to be introduced in the dynamo field, thus cutting down the dynamo output to about 5 amperes, in fact to any quantity required, and so affording full protection to the batteries, ensuring long life and efficiency with the minimum of maintenance cost. At the same time the dynamo, running on practically no load, absorbs little or no power from the locomotive.

Bank Illumination

It is said that the modern tendency of interior illumination of banks is to conceal the source of light in troughs along the top of the bank rails surrounding the tellers' cages, etc. One can appreciate that the entire absence of hanging fixtures will assist in a more uniform distribution. It also tends to give the interior of the building a high and spacious appearance for in the average installation the eye finds it difficult to see past the bright light, and the ceiling is visually lowered besides being unevenly lighted.

The accompanying illustration shows an interior view of the Swedish-American Bank at Balmoral and Clark Sts., Chicago. The main banking room is 52 feet long, 32 feet wide, and 26 feet high. The reflectors are contained in the casing on the bank railing which stands 9 ft. above the floor. It can be seen from the movement of the minute hand of the clock in this photograph that the exposure was about seven minutes. No light was used except that supplied by the general system of illumination. It is said that this installation is kept burning evenings solely on account of the attention it attracts and the advertising value it possesses.

Properly diffused light.

The illumination is accomplished by two reflectors, carrying 60 watt lamps, contained in each of the eight boxes or troughs along the bank rail over the tellers' wickets, etc. In addition there are four reflectors using 150 watt lamps over the vestibule entrance. There are two skylights in the ceiling for day lighting purposes and these are also utilized at night by placing eight 100 watt lamps in suitable reflectors above the skylights.

This installation was made by the Pierce Electric Company, Chicago. The equipment used was supplied by the National X-Ray Reflector Company.

A by-law will be submitted authorising the expenditure of $10,500 for extensions and improvements to the electric light plant in Outlook, Sask.

Tungstolier Company Has New Showrooms

For the past several years the Tungstolier Company have not attempted to have any more than a sample room in which to show their fixtures; but since they are manufacturing in Canada, and their line has grown so rapidly, they decided to equip a real first-class showroom. The Tungstolier showroom is located on the fourth floor of the Canadian General Electric Company's building, corner King and Simcoe streets.

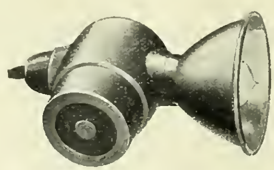
Corner of the Tungstolier showrooms.

A specially prepared room is set aside for displaying semi-indirect fixtures where the ceiling is so arranged as to give maximum results. Each semi-indirect fixture has a separate switch so that these can be shown to the best advantage.

The Tungstolier Company have endeavored to cover practically all the field for high grade lighting fixtures. They wish to emphasize that their showrooms are for the use of the many dealers and other friends who have been handling Tungstoliers. They also anticipate that with this valuable addition to their organization many new friends and customers will be made.

Magnetic Handy Lamp

The Adams-Bagnall Electric Company are placing on the market a very handy type of lamp for use with automobiles or around machinery of any kind. The lamp is a low voltage type and is designed to operate from a storage battery. The specially handy feature about this new devise is a small electro-magnet with one end of the core exposed so that by simply placing this core against any piece of iron the lamp is held firmly in place. On automobiles it will cling to the axle, springs, hood or a dozen and one other places where light is required in case of accident. One view of this lamp is shown herewith.

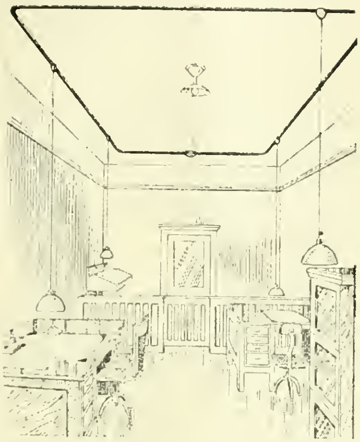


Will cling to any iron material.

The Dealer and Contractor

Office Wiring Suggestion

The cut herewith shows a system of distribution with metal moulding which is designed to meet the requirements in rented properties where no two tenants specify the same amount or distribution of light. The circuit is picked up in



Good wiring arrangements for renting quarters.

this instance by a conduit junction box shown at the far end of the ceiling, and the ceiling was panelled with the moulding placed 16 inches from the side wall. Four flat elbows, and four rosettes complete the installation which was painted to match the ceiling. This makes a good job and also a good looking job.

Substations at Low Cost

The estimated cost of equipment with its installation has been the means of delaying the supply of light and power to many a promising customer. In this class may be included small factories, dairies and small towns which may be found in the neighborhood of practically every transmission line and where there is always considerable demand for electric current. For this class of business the out-door sub-station seems to possess many advantages over the old established system of housing everything, the chief advantages claimed being: 1, flexibility of operation; 2, low first cost; 3, ease of installation; 4, ease of inspection; 5, reduction of transmission losses on low tension feeders. The accompanying photograph illustrates an installation which is typical of a number recently made by the Transmission Engineering Company, of Pittsburgh, and which are said to be giving entire satisfaction. The photograph represents a 100 kv.a., 3-phase, 60 cycle out-door sub-station which is reducing the voltage from 22,000 to 2,200, 440,220, and 110. The small building to the left houses a rotary convertor, used in this particular case to supply direct current for mine service. Except in the exceptional case where direct current is necessary, all buildings can be dispensed with as, in the regular transformer equipment, no moving apparatus is required.

Perhaps the most interesting feature about this particular installation is its low cost, which, it is claimed, will not exceed $12.50 per kw. of installed capacity, the cost being distributed as follows:—

1 tower and equipment of switching and protective apparatus	$356.00
1 100 kv.a., 3-phase, 60 cycle transformer	850.00
Labor of erecting sub-station	44.00
Total cost of sub-station	$1,250.00

If to this is added the cost of 500 ft. of No. 4 wire, 3 phase, 22,000 volt transmission line, estimated to cost $200, the total cost of installation amounts to $1,450.

It is interesting also to note the probable income from an installation of this sort. On the supposition of a 30 per cent. load factor during a ten hour day, 300 days per year,

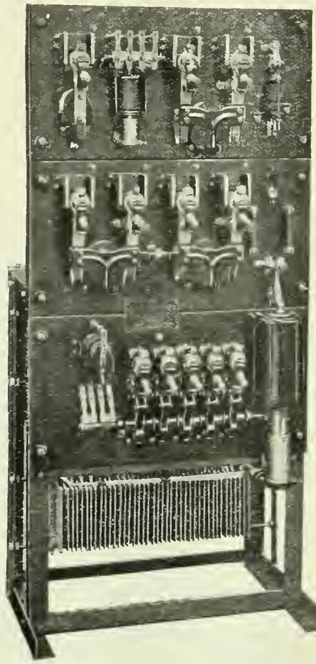
Out-door sub-station suitable for small towns.

the total power consumed would be 90,000 kw. hours. At 1½ cents per kw. hour the gross income would therefore amount to $1,350. Deducting 50 per cent. for operating costs and 15 per cent. for interest and depreciation, which appears ample in each case with this type of equipment, there is a net yearly profit of $450, which is slightly in excess of 30 per cent. on the original investment. Such an installation would therefore pay for itself in less than four years.

The Tweed Electric Light & Power Company are reducing their capital stock from $40,000 to $24,000.

Elevator Controllers That Insure Safety

In the elevators of the many hundreds of business buildings in the country millions of people are carried every day. When this great number is considered the feature of safety looms up as of greatest importance. Elevator accidents are particularly gruesome and it is unnecessary to say that the choice of elevator control equipment should be given the greatest consideration. In the design of the Cutler-Hammer full magnetic type elevator controller the control system is laid out so that even should grounds or short circuits occur in the cables or switches, no damage to the elevator or its occupants can result. Failure of any part of the equipment to function propertly results in the slowing down of the elevator and bringing it to a stop. The latest design of controller, the panel of which is shown in the accompanying illustration permits of all the refinements of control that can be used in connection with direct current motors.



Full-Magnetic Elevator Controller Panel.

These standard controllers are furnished in either single-speed or two-speed types, both types being equipped with the slow-down feature. The single-speed types are used with motors that have no field control. The two-speed controllers are used with motors having additional speed variation by means of shunt field resistance. The slow-down feature is obtained in both cases by means of the combination of armature series and shunt resistances. The armature shunt resistance is used also for dynamic braking. Single-speed equipments are generally used for moderate speed elevators, while standard two-speed controllers are used with elevators operating at high speeds and this design of controller can be arranged for use with the very highest speed elevators possible.

The magnetic switches mounted on the slate control panel are simple and rugged in construction and can easily be taken apart for inspection or for renewal of the contacts. All switch arms have a channel section and the other parts are heavily ribbed where required so as to eliminate the breakage of any of these parts. All electrical contacts on these panels are "butt" type, carbon to copper. These contacts have a wide range of adjustment for taking up wear, thus insuring maximum life. Dust and dirt cannot collect on the contacts because they are vertical. The main contacts are equipped with magnetic blow-outs, the blow-out coil being of bar wound copper mounted on the back of the control panel, so that these coils cannot burn out nor be damaged from the arc itself. All of the wiring is exposed on the back of the panel and all terminals are accessible. A double-pole main-line switch breaks both sides of the line and in connection with the direction switches gives four breaks in the armature circuit. The direction switches are mechanically interlocked to prevent their simultaneous operation which would cause a short circuit on the line. These switches will automatically open on abnormal drop in voltage and stop the equipment. A double coil overload movement is arranged to stop the elevator in case of overload and can be automatically reset by throwing the car switch to the off position. This gives a reliable indication as to whether the car is overloaded and by having the resetting feature in the car switch, it is possible to set this overload within the closest limits. This device therefore possesses an advantage over the hand-operated circuit-breaker in that the operator is not compelled to go to the switchboard in case a slight overload occurs. The only thing necessary is to lighten the load on the elevator. With a manually operated circuit-breaker the operator, under these conditions, invariably increases the current setting of the breaker when he goes to the panel to reset it and, in case of continued tripping, eventually ties the breaker in; thus eliminating the overload protection which the circuit breaker is designed to give.

The Maximum Demand Meter

An interesting type of meter is being placed on the Canadian market by the Siemens Company of Canada, the purpose of which is to show, in addition to the kilowatt hour consumption, the maximum demand in watts or kilowatts averaged over some definite period of time; an indicator pointer always shows the highest value on watts demanded continuously, averaged on, for example, a fifteen minute basis. The following description and sketch will assist in making the construction and operation of this meter better understood.

The figure herewith is a diagrammatic sketch view, showing merely the essential parts and their relations, in order to make the description of the construction and operation clear. Referring to the drawing, the induction meter system of a single or polyphase meter is represented by the single armature disc and spindle A, and the meter brake or drag magnet Mg. The worm S. gears into the worm-wheel S_2, and drives the kilowatt-hour counter W in the usual way through appropriate ratio wheels. A pinion on the arbor of the worm-wheel S_2 gears into the wheel V, and on the arbor of V is fixed the wheel B normally in gear with the wheel M, thus forming the connecting link between the meter and the maximum indicator pointer Z.

The pre-determined time period is given by a timing gear consisting of a simple induction motor element E and armature disc B_1, driving a suitable train of wheels ending in the tripping cam C. The speed of this motor-driven timing gear is controlled by a hair spring and escapement Hs. The cam C is arranged to trip the rod RD, which rests up against the bar Ab, pivoted at P. The bar AB is so arranged that its movement controls the arbor of the wheels V and B, an upward movement of Ab serving to disengage the wheel B from the wheel M. To the wheel M is fixed a spring R, so that rotation of wheel M, when driven by wheel B, takes place against the tension of spring R, and if B is

disengaged by the upward movement of Ab, the wheel M returns under the pull of spring R to its zero position.

To the wheel M is fixed a carrier pin St, which serves the purpose of engaging and carrying with it the pointer Z against the friction of spring F, which exerts sufficient

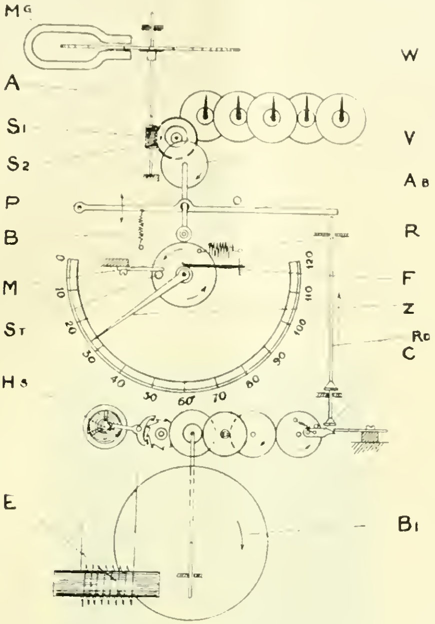


Diagram of maximum demand meter.

pressure to retain the pointer Z at any position it may be carried to by the pin St.

Method of Working

The rotation of the meter system A is through the worm and wormwheel S_1 and S_2 communicated to and registered by the counter W, which is geared to read direct in kilowatt-hours in the ordinary well-known manner; also the rotation of the meter system is communicated in the same manner to the wheel V by a pinion on S_2. Since the wheel B is fixed to the arbor of wheel V, the motion is further carried on to wheel M to which the pin St is attached. Assuming the pointer Z to be at zero on the scale, it will be clear that the rotation of the meter system will cause M to revolve, and so cause the pin St to engage and carry with it the pointer Z over the scale.

The motor driven timing gear, the speed of which is kept constant by means of the escapement device, controls the cam C through a suitable set of ratio wheels, which in turn trips the rod RD at some pre-determined and recurrent interval of time such as every 10, 15, 30 or 60 minutes.

The tripping of the rod RD will cause the lever bar Ab to momentarily lift, and so disengage B, allowing M with pin St to return to zero under the pull of spring R, leaving Z under the retaining friction of spring F to indicate on the scale the distance travelled by the pin St on the wheel M in the chosen time period. The tripping and disengaging is only a matter of a second of time, as immediately the cam C trips the rod RD, the latter is allowed to fall again to its normal position, so bringing the lever bar Ab back, which, in turn, allows the wheel B to engage again with M, and so repeat the cycle of operation.

It will be seen, therefore, that since the time period of engagement is constant and recurrent, the position of the pointer Z through the medium of the gear S_1, S_2, V and B is directly dependent on the number of revolutions made by the meter armature in the chosen time period. The result is that the position of the pointer Z is a measure of the maximum load averaged over the chosen time period.

G. R. S. Selectors on the New York Central

The New York Central Railroad has awarded the order for telephone selector equipment for their West Shore Line, Albany to South Utica, to the General Railway Signal Company of Rochester, N.Y. This circuit comprises 42 selector stations and is 118 miles in length, the dispatchers office being located at Albany. The order specifies G. R. S. power equipment, including an a.c.-d.c. motor-generator set and a power switchboard with accessories. The motor generator will be operated from a 25-cycle, 110 volt commercial circuit, which is available at the dispatcher's station. The installation will be the third circuit on the New York Central Railroad to be equipped with G. R. S. selectors and power equipment, since a trial installation, placed in service April 20th, 1912, and the sixth circuit to be equipped with power equipment.

Gasoline Torches

The accompanying illustrations are representative of equipment manufactured by the P. Wall Manufacturing Supply Company, Pittsburgh, Pa. Fig. 2 is a half-pint size and operates without a pump, generating its own gas by heat from the burner, and producing an intensely hot blue flame. This size is light, substantial and occupies small space in a mechanic's kit. For Fig. 3 it is claimed that never before has

Fig. 1.

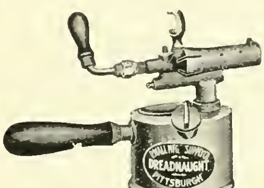


Fig. 2.

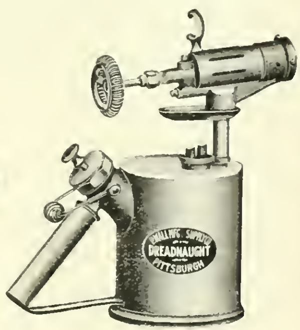


Fig. 3.

there been a blow torch that would produce such a variety of flames. Everything from a small pointed intensely hot flame to a powerful blow pipe flame is obtained by simply turning the needle valve. This is an ideal electric torch for soldering fine wires, for commutator work or heavy cables. Fig. 1 represents a conduit holder, another specialty manufactured by this company.

The Electrical Department of the H. W. Johns-Manville Company, New York, announces that it has recently completed the installation of lighting fixtures to the value of $19,590 in the New York Central R. R. Company's new station at Rochester, N.Y.

It is reported that the matter of the purchase of the British Columbia Electric Railway system by the city is being seriously considered by both parties.

Lecture on Illumination

In the absence of Mr. G. M. Gest, who is in England, and consequently deferred his promised paper on underground construction, Mr. C. A. Howe, of the Holophone Company, Toronto, addressed the members of the Montreal Electrical Society on October 17. Mr. Howe spoke on recent advances in illumination, tracing the development of electric lighting. He pointed out that illuminating engineers first of all studied the placement of lights, and then turned their attention to the quality of the light. Lately, engineers had been studying the subject of glare, and Mr. Howe remarked upon the efforts made to minimize this effect. He also spoke upon the advantages of direct and indirect lighting and gave the results of recent experiments in this direction. The Ontario Hydro-electric Commission were doing much to educate the public in the use of electric light by means of their window displays in Toronto. The speaker also described the process of manufacturing some of the shades he exhibited. Many questions were asked, Mr. Howe elaborating many of his points in replying.

The Most Resistant Wood

Genuine greenheart has the reputation of being the most resistant wood to the attack of marine borers and to decay. Borers are especially bad in tropical waters. The wood is, in addition, hard, heavy, and durable, and not subject to damage from impact and wear. Indisputable records show that the best grades of this wood surpass iron and steel as to lasting qualities in contact with salt water. It has been known and used since 1769. Logs have remained intact under water for one hundred years. Lock gates in English canals have been made of it for years, and the only limit of their durability so far has been the length of service of their iron bolts and fastenings, which usually can be renewed without much trouble. Greenheart in Liverpool lock gates built in 1856, removed to allow a deepening and widening of the ship channel in 1894, was used over again when the gates were reconstructed. The sills and fenders of the lock gates at Panama will be made of greenheart, and much of the docks will be constructed of the same material.

New Office of Cutler-Hammer Company

The Cutler-Hammer Manufacturing Company, Milwaukee, manufacturers of electric controllers, have recently opened a new district office in Cincinnati located in the Fourth National Bank Building. The general increase in business has made it necessary to establish a permanent office in Cincinnati. Mr. Horace L. Dawson, formerly of the engineering department of the company, and recently one of the sales engineers connected with the Chicago office, will be in charge of the new office.

Large Order for Rotary Converters

The Siemens Companies have recently been awarded further contracts in connection with the government electrification of the suburban railways of Melbourne, Australia. These further orders comprise eleven 2,000 kw. rotary converter sets complete with transformers, rheostats, diverters, starting gear, etc. This now brings the number of rotary converters in connection with this order up to the following:—25 rotary converters 2,000 kw. capacity each; 10 rotary converters 1,000 kw. each; and 4 rotary converters 500 kw each. This probably represents the largest order for rotary converters ever placed.

The town council of Welland have voted another $20,000 to cover further extensions of the electric distribution system.

New Companies

The North American Development and Construction Company, Limited, has been incorporated with head office at Winnipeg.

Applications will be made to the Legislative Assembly of the province of Ontario at its next session to incorporate the London, Grand Bend and Stratford Railway Company.

A charter has been granted to the Southern Canada Power Company, head office Montreal. Mr. C. H. Cahan, Jr., son of the president of the Western Canada Power Company is one of the provisional board of directors.

Geo. C. Rough, Hercules

At the annual meeting of the Jovian Order held in New York City, October 14, 15 and 16, Mr. Geo. C. Rough, 512, of the Packard Electric Company, Toronto, was elected to

Mr. Geo. C. Rough, 512.

the office of Hercules for the Twelfth Jovian Congress 1913-14. At this annual meeting it was also decided to make Canada a separate district.

C. G. E. Publications

The Canadian General Electric Company have issued the following:—The Illumination of Construction Work describing the value of proper night illumination and its possibilities with the type W flame arc lamp. "Iron clad-exide" Battery for electric vehicles, describing batteries and their accessories. Efficiency Round-house Lighting, a booklet explaining the proper type of reflectors, condulets, etc., required in the correct illumination of the round-house. Bulletin M, describing metal shades, mirror reflectors, border and footlight reflectors, portables, etc., manufactured by the Wheeler Reflector Company, for which the Canadian General Electric are Canadian agents. Condulets, manufactured by the Crouse-Hinds Company of Canada, are handled by the C. G. E. Company. Bulletin No. 101, deals specially with a new type of condulets for railway requirements. Bulletin 4972 describes the KR system of voltage regulation which is controlled in Canada by the Canadian General Electric Company.

Current News and Notes

Aurora, Ont.

A contract has been awarded to the Canadian Allis Chalmers, Limited, for the supply of electric pumps required in connection with the town water system.

Ayers Cliff, Que.

It is reported that the electric light franchise, which has yet a number of years to run, has been purchased by the Sherbrooke Railway & Power Company.

Brandon, Man.

Work is in progress on the new car barns. Tenders will shortly be called for nine new street cars.

Brantford, Ont.

An extension of time has been granted the Grand Valley Railway Company in which to comply with the conditions of their franchise.

Brockville, Ont.

The town council has passed a by-law to expend a further $69,000 in the light and power department.

Calgary, Alta.

Tenders have been called for next year's supply of service transformers.

The Imperial Wire & Cable Company have been awarded the contract for the supply of 40,000 feet of lead-covered, paper-insulated underground cable.

Chatham, Ont.

The city council will secure an estimate from the Hydro electric Power Commission of Ontario as to the value of the local plant, so that unnecessary distribution duplication will be avoided.

Dryden, Ont.

The Dryden town council have made a new agreement with the Dryden Timber and Power Company under which lower rates have been secured. The company is allowed the use of the transformers, cable, poles, etc., belonging to the municipality and gives the following rates:—8 c.p. carbon lamp, 3/4 cents per night; 16 c.p. carbon, 1 1/2 cents per night; 32 c.p. carbon, 3 cents per night; 40 watt tungstens, 3 cents per night. A discount of 10 per cent. is allowed on all accounts.

Edmonton, Alta.

The employees of the Edmonton Radial Railway system have formed an association for the study of first aid to the injured. At the first meeting 28 members were enrolled.

Superintendent Parsons of the power plant has recommended the purchase of a 400 kw. street railway generator to be operated by a Belliss & Morcom engine, with condensing equipment.

Forest, Ont.

A contract has been awarded to the Central Electric Supply Company for a quantity of insulated copper wire.

Fort William, Ont.

The Orpen Conduit Company are contemplating the erection of a factory in Fort William, Ont.

Contracts have been awarded for repair shop machinery to the A. R. Wiliams Machine Company, Mussens Limited, and the Canadian Fairbanks-Morse Company. The repair shops and car barns are being placed in readiness for the taking over of the local street railway system by the municipality, on January 1st.

Gowganda, Ont.

The Miller Lake O'Brien Mine are developing a series of rapids at the outlet of Gowganda Lake in the townsite of Gowganda. The total fall is 27 ft. in a distance of 2,300 ft. The dam will be about 100 ft. long and water will be delivered from there to the turbines by a 7 ft. diameter tubular wooden flume about 1,500 ft. in length. Two sets of Barber wheels each capable of developing 400 h.p. are being installed and these will be belt connected to a 750 h.p. generator.

Guelph, Ont.

The Hydro-electric Power Commission of Ontario will be asked to furnish estimates of the cost of an electric railway line connecting Guelph with Fergus and Elora. The line would run along the same right of way as the transmission line which it is expected will be built shortly.

Halifax, N.S.

The Canadian Westinghouse Company are supplying Acadia Sugar Refining Company of Halifax, N.S., with the following equipment:—three 750 kw. bleeder type, turbo-generator units, 3-phase, 600 volts, 7,200 alternations, 3,600 r.p.m.; one 11 panel switchboard for controlling the 3 turbo-generators, exciters, feeders, etc.; 45 a.c. 60-cycle motors having an aggregate capacity of 700 h.p.

Hamilton, Ont.

Engineer Sifton estimates that additional equipment to the amount of over $300,000 will be required in connection with the Hamilton distribution system.

The Dominion Power & Transmission Company have been granted a permit to build a freight shed to cost $5,000.

The Dominion Power & Transmission Company may erect a 40-pole extension to their electric light service in Mount Hamilton.

Kingston, Ont.

A petition of the ratepayers has been presented to the council asking that sections of Brock and Wellington Streets have all poles removed and wires placed underground as is being done on Princess Street at the present time.

Langham, Sask.

The town of Langham has recently installed a 50 h.p. producer gas engine generator set for supplying light to the town. The equipment was supplied by the British Canadian Engineering & Supply Company.

London, Ont.

Plans are being prepared by the Hydro-electric Commission on a fourth sub-station to be located in East London. Equipment will also be required.

The important question of the electrification of the London and Port Stanley Steam Railway was decided on October 22nd in favor of electrification, by the passing of a by-law authorizing the expenditure of $700,000 for this purpose.

Ottawa, Ont.

Ottawa & Hull Power and Manufacturing Company have decided to increase their power plant by the addition of two water wheel type alternators each 6,750 kv.a., 120 r.p.m., 2,300 volts, and also two transformers each 6,750 kv.a., 2,300/12,000 volts. The contract for this addition has been awarded to the Canadian General Electric Company, Limited.

Superintendent F. D. Burpee and R. A. Baldwin, of the

Ottawa Electric Railway, attended the convention of the American Street Railway Association held in Atlantic City, N.J., during the week of October 13th.

Owen Sound, Ont.

It is understood that the town council have decided to accept the offer of the Ontario Hydro-electric Power Commission to supply Owen Sound with 1,500 h.p. of electric energy to be supplied from Eugenia Falls.

Peterborough, Ont.

The city council has passed a by-law dealing with the expropriation of the Peterborough Light & Power Company's distribution plant. Unless the company is willing to accept $95,000 in payment for their property expropriation proceedings will be commenced.

Port Alberni, B.C.

The council is negotiating for the purchase of electric power from the Richie-Agnew Power Company.

The B. C. E. R. Company will install thirty 100-watt street lights here and maintain them at a monthly rental of $1.50 during the summer and $2.25 during the winter; lights to be extinguished one hour after midnight.

Quebec, P.Q.

The Battlefields Park Commission have awarded the contract for the electric lighting of Battlefields Park to the Quebec Railway, Light, Heat and Power Company. Previous reports of this contract being awarded to another company were premature.

Regina, Sask.

A contract has been awarded to the Canadian Fairbanks-Morse Company for the supply of the required pumping unit.

The operating returns of the Municipal Street Railway system for the week ending October 4th are as follows:—gross revenue, $3,650; passengers carried, not including transfers, 88,265. Corresponding figures for the week ending October 11th are $4,227.50 and 99,840.

Rougemont, P.Q.

The Canadian General Electric have obtained the contract for equipping the sub-station at Rougemont, P.Q., of the Montreal & Southern Counties Railway. The equipment consists of a 300 kw. motor generator set, a bank of transformers, high and slow tension switchboards, lightning arresters, and switching apparatus.

Saskatoon, Sask.

The City Commissioners have informed the Council that Saskatoon is in a position to supply the Dominion Government Interior Elevator upon which work has already commenced, with electric power at the low rate of 1.6 cents per kilowatt hour.

Sault Ste. Marie, Ont.

The Michigan and Lake Superior Power Company and the Algoma Steel Corporation are making application to be allowed to build a dam across the St. Mary River for the development of electric power.

Smithville, Ont.

Mr. H. Gracey, furniture dealer, is said to be considering the erection of a small gasoline electric plant with storage battery auxiliary. The maximum requirements to be in the neighborhood of 1,000 candle power.

South Porcupine, Ont.

The Dome Mines Company, Limited, South Porcupine, Ont., have awarded a contract to the Siemens Company of Canada for one 450 h.p., 250 r.p.m., 550 volts, 25 cycles, slip-ring type induction motor with short circuiting and brush lifting device, pedestal bearing, together with a Siemens type liquid starter. The motor will be used to drive a Belliss & Morcom compressor.

St. Catharines, Ont.

On October 30th a by-law will be submitted asking authority to expend $116,000 on a distribution system. Of this amount $26,000 would be expended on underground equipment and its installation. On the same date a by-law will be submitted extending the franchise of the Lincoln Electric Light Company for three years.

Swift Current, Sask.

A contract has been awarded for the erection of the new power house to the G. C. Gillstrom Contracting Company.

Three Rivers, P.Q.

Shawinigan Water and Power interests are identified with a project for constructing an electric railway in Three Rivers, P.Q. The company will be known as the Three Rivers Traction Company, and propose to construct a line connecting the city with Berthier in the west and Portneuf in the east. The incorporators of the company are J. Aldred, Thomas McDougall, Howard Murray, Julian C. Smith, W. S. Hart, of Montreal, and Denis Murphy, of Ottawa.

Toronto, Ont.

Tenders have been called and will be received up to November 25th for one or more seven and a half million and twenty million Imperial gallon pumping engines; also three water tube boilers with piping and coal handling apparatus, to be installed at the high level pumping station.

The valuation on the Toronto Street Railway Company's system, as recently handed in, names $9,894,482 as the value of the physical assets of the company at the present time. By placing $10,713,553 on "intangible" assets, of which the chief is the franchise, the total value of the system is raised to $20,608,035. It is further estimated that the value of the radial lines within the city limits amounts to $336,486. The value of the Toronto Electric Light system has been placed at $6,132,754. The price placed on these two properties together by the owners is $30,000,000. This is in excess of the combined values of the physical assets of the two systems ($9,894,482, $336,486 and $6,132,754) by more than thirteen and a half million dollars.

Transcona, Man.

The city of Winnipeg have received tenders for three 600 kw. transformers for the G. T. P. shops here.

Contracts are called by the Commissioners of the Transcontinental Railway, Ottawa, for the furnishing and installing of the electric wiring requirements of the car shops at Transcona.

Welland, Ont.

The Electric Steel and Metal Company have called for tenders for the construction of four buildings at Welland, Ont.

Winnipeg, Man.

The Houston Company, Limited, electrical supplies, have opened a branch at Portage la Prairie.

Tenders will be received up to November 4 for switching gear and accessories required at Point du Bois.

Woodstock, Ont.

It is stated that before the first of December over fifty farms in the county of Oxford will be using electric power in one form or another. The uses to which power has been put includes threshing, silo-filling, wood-cutting, grain-chopping, milking and for operating various household appliances.

Yorkton, Sask.

The contract has been awarded to Messrs. Ritchie & Watters for the erection of a brick construction electric power house.

Electrical News

Generation, Transmission and Application of Electricity

Published Semi-Monthly By

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Are You An "Expert"?

This apparently is an age of "experts." The atmosphere seems filled with "experts." The press with every issue creates "experts." And if by chance the press misses anyone, that person hastens to create himself an "expert." It is a title requiring no qualification, pre-supposing no knowledge, representing no experience, but it deceives the uninitiated. If it did not deceive it would be harmless; it would simply be laughable; but just in-so-far as it deceives the unwary it is to be condemned.

There was a time in bygone days when, for example, a properly qualified electrical engineer, a man of education and experience in his chosen profession, was considered a suitable person to consult in matters pertaining to electricity. That is all changed, however, and now it is the press-made, self-styled "expert" whose report is asked. We have the telephone "expert" with his stock-in-trade of prejudices and statistics, the railway "expert" whose name is a stranger to railway men, the wiring "expert" whose knowledge consists perhaps in having read a few catalogues, the lighting "expert" and so on—the air is full of them. One of the worst features of the situation, too, is that these "experts" are doing a lot of work and they are doing it as badly, and with as poor judgment, as possibly could be expected.

We do not mean to argue that a college education is a necessity before a good man can become reasonably proficient in the various lines of the electrical industry, though it helps, generally. What we do believe is that a man needs either theory or wide experience. If both are available so much the better, but the spectacle of an undertaking, involving perhaps millions of dollars, being advised upon by a man with neither, would be ludicrous in the extreme if it were not so costly financially. Yet our towns and cities are doing this very thing daily, entrusting important matters to, or following the advice of, self-styled "experts" and paying, both directly and indirectly, big money for their mistakes.

We do not pretend to be able to suggest an immediate remedy. The medical profession has been in existence for a long time and still "quacks" persist. In this case, however, the public has grown wiser with time and the laws of the land afford a measure of protection. Until we can legislate against incompetence in the electrical profession the market will doubtless be flooded with "experts," but in the meantime much can be done to educate the general public and especially the executive officers, such as councils, boards of control, etc. On these we would impress the necessity of employing engineers of reputation and experience, recognized among their fellows as trustworthy and capable, and known widely for the good work they have done. There are plenty such men ready to undertake work and deserving of it. This ability to descriminate would mean much to the engineers themselves, much to the electrical industry as a whole, but much more to the municipalities. Don't be deceived by the alluring title of "expert." In many cases it spells "quack." Be satisfied with a properly qualified and widely experienced engineer.

What to Give

Speaking of birthdays—well, they come around often enough. And do you know, many people dread them? No, not what you think—not because they are getting old, though that bad's enough, but for a very childish reason—they don't know what to give the birthdayee. And it's the same with anniversaries and the weddings which are going to be anniversaries sometime. Did you never see them in the stores? You can pick them out of the crowd anywhere by the hunted, worried expression, even if you are not near enough to hear the remark, "What shall I give those people?" To many persons, possessed of ample means to gratify their friends' taste, the approach of one of the occasions is a genuine calamity. They have thought out the general principle—it must be something of value, yet not too costly, unique without being trivial, ornamental but useful, something which will be of real service to the recipent and incidentally a reminder of the giver's thoughtfulness and good taste in selection—but they are helpless when it comes to the application.

From the many electrical devices for table use you can always be sure of finding a generous number that will fulfil all these conditions. Choose the one which after examination you feel that it will be difficult for you to get along without yourself, and you are apt to be on the right track. These utensils are so beautiful in design that they hardly suggest cooking—merely the pleasure of eating, rather. First ascertain if your friend's house is wired for electricity—it will be if it is a modern house—then come to our showroom and we will help you make a selection that will strengthen the bonds of friendship by the gift which you offer.—Electric Service Magazine.

Prince Rupert Dry Dock

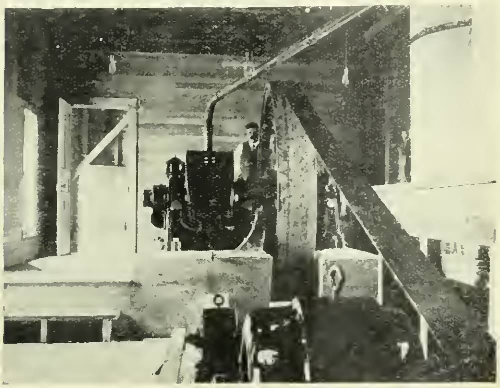
The new G. T. P. floating dry dock at Prince Rupert, B.C., will be one of the largest and best equipped in the world, and will be electrically operated throughout. The contract for the electrical equipment which has been awarded by the G. T. P. to the Canadian General Electric Company, Limited, includes two 200 h.p. and four 100 h.p. variable speed induction motors, with full automatic control, for operating the pumps on the dock. The power will be produced by two 1250 kv.a. Curtis steam turbo-generators with complete condensing apparatus. The exciters for the main turbine-generators will consist of three 35 kw. turbine-driven

generators, and one motor generator set. The foundry, machine shops, and ship yards will be equipped with motor-driven tools, requiring motors ranging from 60 to 10 h.p. The contract for electrical equipment also includes all necessary power and light transformers.

New Plant in Outlook, Sask.

Mr. Jas. H. Wilson, superintendent of the new municipal plant of Outlook, Sask., and town electrician, sends us the following brief description of their installation.

The motive power is a suction gas engine operated by producer gas. It is a Ruston-Proctor equipment supplied by the British Canadian Engineering & Supply Company of Winnipeg. Though some trouble was experienced in operating these units at first, owing to lack of experience with this type of prime mover, Mr. Wilson now reports that the engine has proved to be everything that the makers claimed for it and that it is giving good satisfaction.



Producer-Gas-Electric Plant—Outlook, Sask.

The accompanying photograph shows the generator and exciter in the foreground and the engine in the back ground. The generator is a 50 kw., 2200 volt unit, belted to an engine of 75 h.p. capacity. A 2 kw. exciter is belted to the generator. Current is distributed in the usual way at 2200 volts and stepped down by pole type transformers to 110 volts. The plant commenced operation eleven months ago with only 45 subscribers but this number has been increased to 120 with 10 on the waiting list. The superintendent reports that all indications point to their having to install another unit in the course of the next year.

By-Law for Municipalities

According to a recent act of the provincial legislature every municipality in Ontario is required to appoint a properly qualified inspector who shall test all electrical installations of every kind and approve of them before they can be connected up to the feed lines. This looked as if it might work hardship to the smaller municipalities but where the expense is considered too great a number of municipalities are advised to combine on the appointment, the inspector being required to distribute his time to cover the larger territory as required. Strangely enough any opposition which has developed has come from the larger centres and the Hydro-electric Power Commission of Ontario, in whose hands the matter rests, have found it necessary to bring a certain amount of pressure to bear. This probably represents not so much an antagonistic attitude on the part of the municipalities as a disinclination to make any move for which the council may not understand the immediate necessity and which will add to the expense of operating the system.

Much of the delay has doubtless been caused, however, by a lack of knowledge as to just what course to pursue and the Commission have now drafted a by-law which each municipality may accept as it stands or use as a basis on which to build up a by-law more suited to local conditions. This by-law outlines certain general rules that are to be followed in the organization of an inspection department, the authority of the inspector, the schedule of fees, etc., which is untechnical enough for a council of laymen to understand. No doubt this will meet the requirements of the average municipality and result in the arrangement of an inspection department and the appointment of an inspector without delay. As already pointed out in these pages it is the natural conclusion that municipalities can be held responsible where accidents result as a direct failure to carry out the conditions surrounding electrical installations as required by law. The new by-law follows:—

Form of By-Law for Municipalities of Ontario

Whereas it is incumbent upon the Municipality of .... (name of municipality to be inserted) hereinafter called the municipality, to appoint an electrical inspector or inspectors, hereinafter called the inspector, for the due enforcement of the Rules and Regulations of the Hydro-electric Power Commission of Ontario, hereinafter called the Commission, in accordance with Act 2, George V., 1912, section 22a (1) and (2), it is hereby enacted by the Council of the said municipality that:—

1. Use of Electric Current.

No electric wiring or apparatus shall be installed nor shall electric energy be used for lighting (illuminating, decorative or advertising), power, heating, electro-chemical or other like purpose, except as hereinafter provided.

2. Electrical Installations (Rules to be observed).

The Rules to be observed in the installation of electric wiring, fittings, apparatus or machinery, shall be known as "Rules and Regulations for Inside Electrical Installations" of the Commission, together with such modifications, amendments or additions as may from time to time be approved of by the Commission.

3. Method of Enforcement of Rules.

a. No installation of electric wiring, fittings, apparatus or machinery shall be made, nor shall any alterations or additions be made to any existing installation, until a permit has been obtained from the Inspector for the carrying out of such work.

b. The Inspector may refuse to issue a permit if, in his opinion, the proposed installation will not conform in every respect to the requirements of this By-law.

c. It shall be the duty of any person or persons installing electric wiring, fittings, apparatus or machinery to notify the Inspector (on forms which will be supplied by the Inspector) when any such electrical work is ready for inspection. At least twenty-four hours' notice must be given in all cases.

d. Each application for an inspection shall be accompanied by an amount of money sufficient to cover the inspection fee, as set forth in the schedule given herein.

e. Wiring contractors shall see that proper notices are placed in conspicuous locations warning carpenters, lathers or other persons concerned, not to cover up the wiring until it has been duly inspected. Copies of such notices may be obtained from the Inspector.

f. When the Inspector has had inspected and approved any installation he will cause a notice of approval to be placed in a prominent place where it may be seen by carpenters, etc., who will then be at liberty to cover in the wiring.

g. Information may be lodged with the Inspector by any member of the local police force or fire department or other

person respecting any electric wiring which there is reason to believe is being installed without a proper permit having been issued therefor.

4. Supply of Electrical Energy—Service.

a. No company, corporation or individual, whether operating publicly or privately, will be permitted to install any live service or furnish a supply of electrical energy to any installation for electric light (illuminating, decorative or advertising), heat, power, electro-chemical or other like purpose, until a permit has been granted therefor by the Inspector.

b. The Inspector may, at his discretion, issue permits for temporary service, should these be required.

c. Any company, corporation or individual supplying electrical energy within the limits of the municipality shall, upon the written notice from the Inspector, to the effect that the electric wiring, apparatus, etc., in any premises is in an unsafe condition, discontinue within forty-eight hours the electric service or services from such wires, etc., and must not re-connect the same without a written permit from the Inspector to do so.

5. Organization of Inspection Department.

a. The Inspector is hereby authorized to organize, manage and conduct a department to be known as the Department of Electrical Inspection, hereinafter called the Department, for the due enforcement of the Rules and Regulations of the Commission in the manner set forth in this By-law.

b. The Inspector will have complete control of any or all assistants or other staff which may be necessary for the proper execution of the work of the Department.

c. Before engaging any assistants or other staff, however, the Inspector shall submit a report to the Mayor of the municipality, stating his requirements, together with an estimate of the expenditure of the Department for the ensuing year.

d. It shall be the duty of the Inspector to submit a report each year at a time to be appointed by the Mayor of the municipality, detailing the work which has been carried out by the Department during the preceding twelve months, giving the number of permits issued and inspections made, the amount collected in fees and other such information as the Mayor may require.

e. It shall be the duty of the Inspector to keep such books as will show a proper record of all the transactions of the Department, and he shall, at the beginning of each calendar month, hand over to the Treasurer (or such other person responsible for the funds of the municipality) all the funds collected in the form of inspection fees during the previous calendar month.

f. It shall be the duty of the Inspector to inspect, or cause to be inspected, as quickly as circumstances will permit, all new installations for the inspection of which he has received formal application accompanied by the proper inspection fees, and also to make such re-inspection of existing installations, additions or alterations thereto as may be necessary, in order to minimize the risk of injury to persons or danger of fire.

6. Authority of Inspector.

a. The Inspector, or any of his authorized assistants to whom he may delegate such duty, is hereby empowered to enter upon at any reasonable hour the stage or other portion of a theatre, moving picture establishment, or other place or public assembly wherein electrical energy is used for light, heat or other purpose, either temporarily or permanently, for the purpose of examining the electrical equipment therein or for the purpose of witnessing its use in such places, and he or they are further empowered to enter upon any other premises at any reasonable hour for a like purpose.

7. Settlement of Disputes.

In case of any dispute arising (as to the proper method of carrying out work on any electrical installations or the materials to be employed therein) between wiremen, contractors, or other parties concerned, the Inspector shall decide the matter in dispute.

Should, however, the decision of the Inspector be regarded as unsatisfactory or unjust by those whom it affects, they may apply to the Commission for a ruling, in which case full particulars in writing, setting forth the facts, must be furnished to the Commission and all other parties concerned. Any order made thereon by the Commission shall be final, and disobedience thereof will render the party or parties at fault, liable to the penalty prescribed for such cases under Section 22 of the Power Commission Act of 1912.

8. General.

a. No person shall damage, or interfere with any electrical installation, or portion thereof, which has been inspected or approved by the Inspector, and no person shall leave or place any metal pipe or other metal work in contact with any electric wiring; nor shall any person molest, obstruct or interfere with the Inspector, or any of his assistants, in the proper discharge of their duties under this By-law.

b. This By-law covering inspection work shall apply to all places and premises situated within the limits of the municipality, wherein electrical energy is used, whether the supply be taken from a private or public source.

9. Penalty for Non-observance of Rules and Regulations.

Any corporation, company, contractor or individual violating any of the within Rules and Regulations will be subject to the penalties set out in the Power Commission Act of 1912, as well as those set out in any By-law passed by any Municipal Council in pursuance of Part 22 of the Municipal Act, 1913.

APPROVED SCHEDULE OF FEES.

Incandescent Light Wiring.

1 to 5 outlets	$0.50	
6 to 10 outlets	$1.00	
11 to 50 outlets		.05 each additional.
51 to 100 outlets		.02 each additional.
and over 100 outlets		.01 each additional.

Motors

Electric motors, each	$1.00	
Each additional motor in same plant	.25	

Electric Signs.

Electric signs, each	$1.00	
More than one sign on same building		.50 each additional.

Electric Fixtures—Mercantile and Factory Buildings.

For certificate covering complete fixture installation along with wiring and for same contractor, a charge of $1.00 over and above the wiring inspection fee will be made.

Residential Fixture Inspections.

When fixtures can be inspected along with wiring, a charge of 25c. over and above wiring inspection fees will be made. When special fixture inspections are required or necessary a charge of one-half the wiring inspection fee will be made, rating each fixture as an outlet with a minimum fee of 25c.

Special Inspections.

Where no special fee is provided, inspections may be made at the rate of 50c. per hour, as well as any actual travelling expenses.

Permit Fees.

Note.—Permit fees will be credited on final inspection fee.

For each permit for wiring jobs under $10.00 (estimated value)	$0.10
For installation between $10.00 and $50.00 (estimated value)	.25
For installations over $50.00 (estimated value)	.35

Each job is entitled to as many inspections as circumstances, in the opinion of the Chief Inspector, warrant.

Shows at Toronto and Montreal

The Montreal Electrical Show, held in the Arena from November 1 to 8, was of a popular rather than a technical character. It contained features of interest to certain classes of electricians, but in the main was composed of exhibits of electrical household appliances. In this sense it was of educative value, as making for the wider use of goods in which electricity is employed as the medium either in the form of power or light. The large increase in the demand for electrical cooking and heating devices is sufficient proof of public appreciation of the claims that the devices are convenient, clean, and economical.

The Montreal Light, Heat and Power Company was the chief exhibitor, occupying a large space at the entrance hall. As was natural in a lighting company, they had a well illuminated stand, on which were displayed many heating and cooking appliances, such as electric chafing dishes, water cups, irons, percolators, table range, complete stoves, washers, and an array of lamps. The exhibits, chiefly manufactured by the Simplex Electric Heating Company, Belleville, Ont., showed what can be done in the way of using electricity for cooking and heating purposes—and demonstrations were given of the excellence of electrical cooking. The Montreal company also showed a device for testing lamps and were demonstrating the comparative illuminating power of Sunbeam mazda lamps and the old type carbon lamp.

The George H. Shuman Electric Company, of New Birks Building, Montreal, showed samples of the goods of the National Electric Heating Company, Toronto. These included electric mantle radiators and heaters, and similar products. They also had on view many He-wire drawn tungsten lamps, for which they are Canadian distributing agents.

An exhibit which attracted much attention was that of the Lister-Bruston automatic electric generating plant, an English invention sold by R. A. Lister & Company, Toronto. The plant consists of a low speed vertical gasoline engine, dynamo, switchboard, and controller. It is especially useful for country house lighting and pumping, and is claimed to be economical in use, obviating the necessity for large storage batteries. The engine, which can be run by gas or gasoline, is started by the simple act of switching on the lights and stops automatically when the lights are switched off.

A very attractive display was shown by the Montreal Electrical Society. This was contributed to by the Imperial Wire and Cable Company, the Bell Telephone Company, Northern Electric & Manufacturing Company, Montreal Light, Heat and Power Company, telegraph department of the C. P. R., and members of the society. The stand was divided into sections of the electrical industry, such as power, manufacturing, cable and telephones, etc., represented by the various committees of the society. Thus there were specimens of different cables, wires, cords and materials, and a sample of the first paper insulated power cable made in Canada. The Bell Telephone Company lent samples of the different instruments, receivers, etc., from the earliest days; other exhibits included the complete parts of an Edison storage battery, parts of a 50 kw. transformer and a model of the Montreal Harbour Board's electric transporter.

Mr. E. W. Sayer, of Montreal, had an effective display of lights and shades, and also miscellaneous electrical appliances.

The Boys' Wireless Club of the Y. M. C. A. worked a wireless apparatus, sending messages from one end of the building to the other, and the Technical School showed some small electrical apparatus.

A large collection of X-ray apparatus was to be seen on the stand of X-Rays, Limited, this including a very powerful X-ray transformer and the latest inventions applicable to this branch of electrical science.

Tate Electrics, Limited, Walkerville, Ont., showed two electrical commercial trucks and two pleasure vehicles, one being a very fine brougham suitable for city use.

There were also a number of electric vacuum cleaners on exhibition, including the Tuec and Ohio.

The Toronto Exhibits

The Toronto exhibition which is just getting under way as we go to press promises to be full of interest and information to the general user of electricity. The following list of exhibitors indicates the amount of interest taken by the manufacturers and dealers, in the exhibition.

Factory Products Limited have a very attractive display, including electrical appliances and supplies of practically every description.

The Toronto Hydro-electric System have also taken considerable trouble. Their exhibit shows an ideal dining-room (from the electrical standpoint); an ideal office; an ideal kitchen; an ideal bedroom and an ideal machine shop. The lighting units were supplied by the Tungstolier Company and the Holophane Company.

The Lancashire Dynamo and Motor Company are exhibiting dynamos and motors and an automatic fire alarm system.

A. H. W. Joyner's display consists chiefly of electrical instruments of the well-known Weston type.

The Hydro-electric Power Commission of Ontario are showing their model farm equipment.

The Humane Society are giving a demonstration of a cage for destroying smaller animals by electricity.

Chapman and Walker Limited have a variety of electrical machine supplies and household equipment.

The Chamberlain and Hookham Meter Company are displaying a number of meters.

The Engineering Society of the Applied Science Department of the University of Toronto are represented.

The Onward Manufacturing Company are demonstrating their latest types of vacuum cleaners.

The Jefferson Glass Company are displaying a quantity of their handsome glassware and also giving a demonstration of glass cutting.

R. A. Lister & Company show an isolated gas-electric lighting plant suitable for villages or isolated residences.

Jones & Moore are exhibiting a variety of electric motors and supplies.

J. J. Martindale is demonstrating his Tuec stationary vacuum cleaner. The Canadian Carpet Cleaning Company are also demonstrating one of the Tuec machines.

The Canadian Carbon Company have an attractive exhibit of dry cells, flash lights and a variety of carbon products.

The Canadian Krantz Electrical Manufacturing Company show panel and switchboard supplies.

The Canadian Independent Telephone Company are demonstrating an inter-communicating telephone system.

The Vacuna Turbine Vacuum Cleaner Company are exhibiting a number of their machines.

E. F. W. Sallisbury, electrical contractor, is exhibiting telephones, motors and general supply parts.

The Clements Manufacturing Company have a display of vacuum cleaners.

The Zimmer Vacuum Cleaner Company are demonstrating their vacuum cleaners.

Tate Electrics Limited are showing an electric pleasure vehicle and an electric truck equipped with Tate batteries.

The Electrical Maintenance and Repairs Company are exhibiting lighting fixtures and general supplies.

Death & Watson, electric cars and storage batteries.

The 1900 Washer Company are demonstrating their electrical washing and ironing machines.

Hollow Reinforced Dam at Jordan River

The Vancouver Island Power Company, Limited, a subsidiary concern of the British Columbia Electric Railway Company, Limited, have placed themselves in a position to become one of the most important producers of electrical energy in the Dominion by the completion of the great dam at Jordan River, a work which was undertaken to meet the increased demand from the city of Victoria and environs upon the company's hydro-electric plant there. In addition to the constantly growing industrial demand for light and power in the Saanich peninsula, an increased storage capacity has also been found necessary for the purpose of keeping pace with the extensive development of the tramway system of the B. C. Electric Railway consequent upon the remarkable growth of Victoria and the districts adjoining.

The Jordan River plant is situated at the mouth of the Jordan River on the Strait of Juan de Fuca, about 43 miles from the city of Victoria, the plant at present in operation comprising two electrical units of 6000 h.p. capacity each. Energy is transmitted at 60,000 volts to Victoria and a tie line connects this plant with the auxiliary steam power plant of the Vancouver Island Power Company at Brentwood Bay.

On account of the increased load on the system the capacity of the Jordan River plant will be enlarged by the addition of one 13,000 h.p. unit, bringing the total capacity up to 25,000 h.p., and thus rendering necessary the construction of the Jordan River dam. Prior to the construction of the permanent dam the waters of the Jordan River were diverted by a temporary rock filled crib dam, located a short distance above the site of the permanent dam, into a flume 6 feet in width by 5 feet 9 inches deep, and 6 miles in length, built with a grade of 1 in 1,000. The water was delivered by the flume into the forebay reservoir, formed by the construction of two earth dams, whence it was conveyed through steel pipe lines to the Jordan River power house. Additional storage was secured by the construction of a hydraulic fill dam on Bear

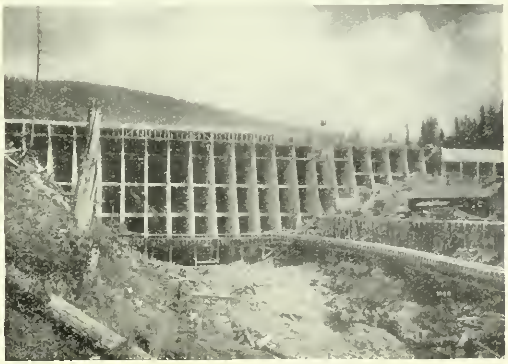
Upstream side Jordan River Dam.

Creek. The waters of Wye Creek were also diverted into the main flume by means of a rock filled crib dam, and the steam known as Alligator Creek has been diverted in a similar manner.

The area of the Jordan River watershed is 67 square miles; the effective drainage area has been found to contain 55 square miles, while the elevation of the effective drainage area is all more than 1200 feet above sea level. The elevation of the watershed is from sea level to 3,000 feet above sea level.

The contract for the building of the permanent dam was awarded the Puget Sound Bridge and Dredging Company at the beginning of August, 1912, and active construction work inaugurated immediately, the entire undertaking requiring just one year to complete. The work consisted of the erection of a hollow reinforced concrete dam of the Ambursen type, together with about seven hundred feet of wooden flume and a small reinforced concrete arch bridge for carrying the flume across the Jordan River. Various types of dams had to be considered, and as it was important to store the autumn rainfall of 1912, an early date for the completion of the work was essential. No sand being available in the vicinity, it became apparent that a dam containing a minimum quantity of material would be required and the Ambursen type of dam was therefore finally decided upon.

The completed dam is about 125 feet high in the highest



Down-stream side Jordan River Dam.

section and 890 feet long over all. Of this length there is 452 feet of bulkhead or non-overflow section, 306 feet of spillway and 135 feet of earth embankment with reinforced concrete core wall. The deck or upstream side of the dam is built on a slope of approximately 1 to 1 and the downstream face of the buttresses on a slope of 1 to 4. On top of the bulkhead section there is provided a walkway six feet wide, which is protected by suitable hand rails and connected at each end of the spillway by stairs with another walk which passes entirely through the dam. The spillway has an eight-foot freeboard and provides for a flood discharge of 25,000 cubic feet per second.

Water is drawn from the reservoir through two sets of Coldwell-Wilcox cast iron sluice gates, each set consisting of two 3 ft. 6 in. x 5 ft. 6 in. gates, either of the sets being capable of discharging sufficient water to supply the demand, except at extremely low water. The gates are all operated by roller-bearing, hand-power hoists set inside the dam, the stems passing through stuffing boxes in the deck. Guides for stop logs are provided for shutting off either set of gates if necessary, and the whole is protected by two sets of trash racks which are mounted on trucks and can be raised clear to the top of the dam if necessary, for cleaning. There is a suitable hand-power winch for raising the racks located on the top of the dam. Heavy concrete counterweights are provided to assist in raising the racks. The storage capacity created by the dam is approximately 615,000,000 cubic feet of

water or sufficient to supply all the electric power at present used in Victoria for five months. With the additional supply of the Bear Creek and forebay reservoirs there is enough stored energy to provide Victoria's power needs for eight months.

Dam Site

The site chosen for the dam proved to be well adapted to the type of dam built and for the efficient location of most of the construction plant. The profile of the site is such that work could be prosecuted on any part of the structure except in the five bays in the river bed, irrespective of the flood conditions of the river. This fact proved of the utmost value during the winter months when the river was subject to sudden and destructive floods.

Solid bed rock was uncovered for the foundations of the entire structure without excessive excavation. This rock provided an ideal foundation, being extremely hard and free from

Crest of Jordan River Dam.

seams and faults. The grain of the rock, and what seams there are, run in a direction parallel to the axis of the dam, thus reducing the possibility of a leakage of water to a minimum and making it easy to secure a satisfactory cut-off for the entire length of the dam. The site also provides an excellent location for the spillway. The waste water after passing over the dam will be discharged into a natural channel which will carry the water away from the dam rapidly and discharge it into the river at a point far enough from the dam to prevent the possibility of damage from cross wash or any scouring action. The greatest difficulty with the site was the impossibility of building a tight cofferdam on the loose gravel and boulders which formed the river bed.

Plant

In general the equipment consisted of the following machinery: two stiff-leg derricks, one 50-ft. and one 60-ft.; boom, with hoisting engines and boilers and an assortment of one-yard wooden skips all used on excavation work on the east bank of the river; one steam-driven compressor operating two Rand drills in the quarry; four one-yard Koppel cars; two No. 2 Aurora jaw crushers; one rotary sand screen; two 24-in. x 30 ft. Superior sand rolls; one 1-yard Kohring mixer, and one half-yard cube mixer; three 1-yard centre-dump concrete buckets; two concrete distributing cars; one cableway of about 900 ft. span equipped with 2¼-in. standing line and specially designed carriage and operated by a two-drum hoisting engine; carpenter shop with circular saw and blacksmith shop with two forges, hand power drill press and bolt machine with capacity up to 1½-in. bolts; three centrifugal pumps (one 10-in., one 8-in. and one 5-in.). All machinery except derricks, cableway and compressor was driven by electric motors with power furnished from the company's plant at the mouth of the river, a seven-mile transmission line having been built for the purpose. Power was transmitted at 6600 volts and stepped down at the works to either 2200 or 220 volts as required. Sheds were provided for the storage of cement, having a capacity of about 75,000 sacks, in connection with which there was a testing laboratory equipped for making the usual tensile tests on cement.

Under the terms of an agreement with the city of Victoria the initial expenditure on the Jordan River power plant by the Vancouver Island Power Company amounted to $1,500,000. To this sum must now be added the cost of the dam, totalling $550,000, together with another expenditure of $450,000 to enlarge the existing generating plant. The work of erecting the dam was under the supervision of Chief Engineer Mr. G. R. G. Conway and Mr. G. M. Tripp, engineering superintendent of the company, and his assistants, Mr. C. A. Lee, resident engineer, and Mr. W. Faust, superintendent of construction. A complete inspection of the plant was recently made by Mr. Wm. Young, controller of water rights. Mr. E. Davis, engineer of the provincial water department, accompanied by Mr. G. R. G. Conway and Mr. Tripp. The work impressed the government officials as being carried on in the most thorough manner possible.

Electricity in Poultry Raising

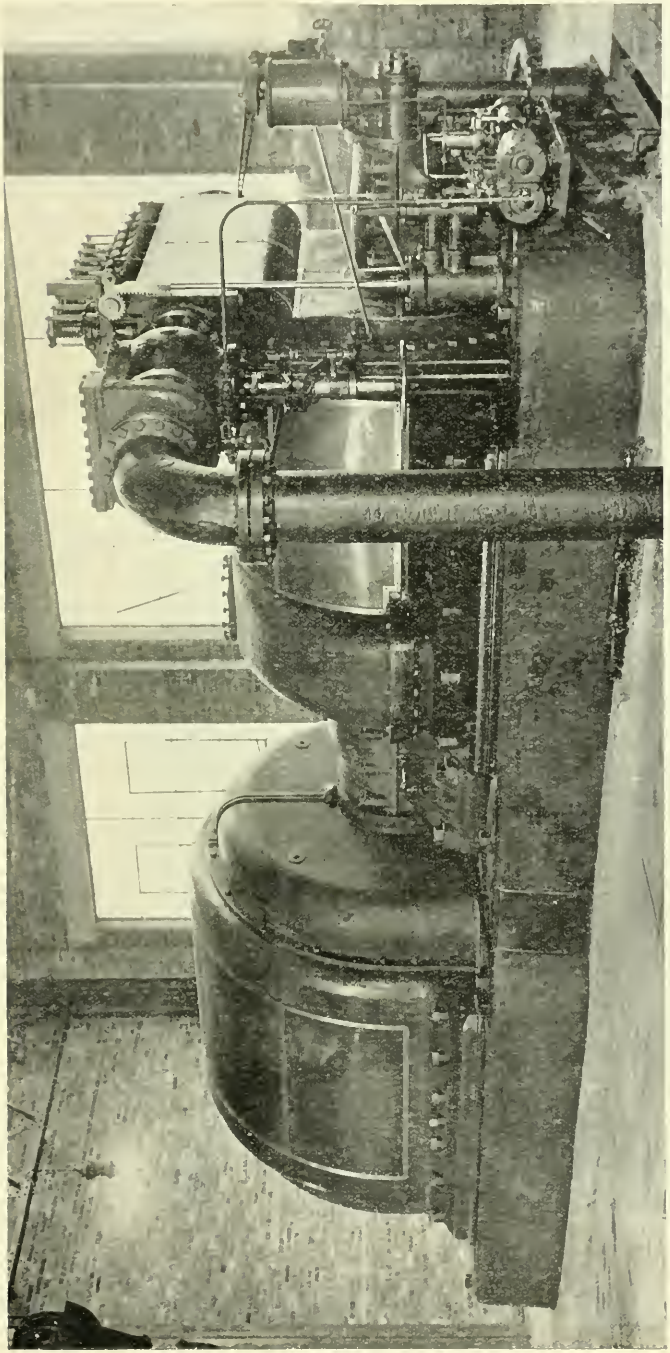
The last weekly report of the Department of Trade and Commerce contains the following item on the experimental use of electricity in poultry raising:

"Experiments have been carried out by Mr. W. H. Cook, at Orpington, Kent, England, where nearly 200 yards of fowl houses, containing 6,000 birds, on Mr. Cook's poultry farm have been artificially lighted during the dark mornings and early nights since Christmas last, and he states that his total increased output in eggs during the dark months by this system has been between 30 and 40 per cent. His fowl houses are lighted by 300 lamps, divided into 32, 16 and 8 candle powers. These are switched on at six o'clock in the evening. At 9.30 the 16 candle power lamps are employed, and at 10 o'clock the 8 candle power lamps are substituted for a quarter of an hour before the hens are left in darkness. Mr. Cook explains that it is necessary to give a rough imitation of the setting sun, otherwise the hens would go to sleep on the ground and become a prey to parasites. In the case of young artificially incubated chickens the electric light is employed to make them feed longer, and this Mr. Cook has found accelerates their growth during the winter months by almost one-third."

Fort William Electric Railways

The principal topic of conversation heard on the streets of Fort William the past week or more has been the question of operation of the municipal street railway. At a meeting of the city council held Saturday evening, November 1st, it was decided by a vote of 11 to 2 that Fort William would manage separately the Fort William end of the Port Arthur-Fort William street railway, which heretofore has been managed by a joint board of representatives chosen from the two cities. The original charter for the Port Arthur-Fort William street railway was obtained over twenty-two years ago. It will be twenty-one years next March since the street railway has been in operation between the two cities. On December first of the present year Fort William will take over the management of the street railway within the borders of her own boundaries and will operate it as a public utility. Already arrangements have been about completed towards equipment, maintenance, car barns, etc., and it is practically assured that the city will be able to undertake complete management within the time specified.

10,000 Kw. Turbo-Generator for T. E. L. Co.



The Toronto Electric Light Company have just completed the installation of a 10,000 kw. steam turbo-generator—the largest to date in Canada.

The Toronto Electric Light Company have just placed in operation a turbo-generator set of a normal rated capacity of 5,000 h.p.. The turbine is a Curtiss condensing type unit operated under 150 pounds pressure and manufactured by the Canadian General Electric Company. The same company also supplied the generator which is a 12,000 volt, 25 cycles, 1500 r.p.m. unit. This set has a continuous over-load capacity of approximately 9,500 kw. and is, we believe, the largest of its type in Canada.

The set is installed in a newly erected building which is well supplied with both natural and artificial illumination. The whole of the east and west sides of the power house is windowed. Night illumination is supplied by 250-watt tungstens, with steel reflectors, placed well up. The power house is also equipped with a Northern crane of 20-ton capacity.

The turbo-generator unit is installed on the second floor of the building, the floor below being occupied by the condenser which sits right under the turbine. For the foundation, excavation was made to bed rock 19 feet below the surface and this was filled up to the first floor level with a solid block of concrete 30 ft. x 15 ft. Above this the big turbo-generator is supported on six heavy concrete pillars approximately 3 ft. x 4 ft. As a result of the great care exercised in the installation not the slightest vibration is shown in any part of the equipment. The condenser is electrically driven by a 200 h.p., 230 volt direct current motor. The field control is also motor operated.

All control is from the operator's table at a point remote from the equipment. This unit will be kept for emergency purposes only and it has been demonstrated that in 2½ minutes after the signal is received the generator can be supplying current to the line.

The Toronto Electric Light Company with this last addition is now in a position to supply at least 20,000 kw. in case of trouble to both their Niagara lines. This is further supplemented by a storage battery which is capable, by itself, of carrying the peak hour load for several minutes or until such time as the turbo-generators can all be set in operation.

As noted above the units are all controlled from the operator's table. In case of trouble on the Niagara lines a signal is automatically given to the operator and at the same time the storage battery is automatically cut into service. At the same instant the condenser motor of the big turbine is thrown in and the boilers, which are all operated by automatic stok-

ers, also motor-driven, are called into service. In less than two minutes and a half the new turbine will be supplying power to the line and the other two turbines, previously installed, can be brought into requisition in about six minutes. In order that the boiler capacity may be ample, four new boilers are at present being erected, each having a capacity of about 1500 h.p.

It may also be mentioned in connection with the T. E. L. plant that they have recently placed in commission a 1,000 h.p. synchronous converter, one of the few machines of this type to be operated in Canada as yet. This machine shows advantages both in space and efficiency. The space occupied is not more than half that required by one of the older type of motor-generator units and it has an efficiency of between 97 and 98 per cent., as compared with a lower efficiency for the old machines.

Mississippi River Power Company

We are reproducing on other pages of this issue three photographs of the Mississippi River Power Company's plant at Keokuk, Iowa. According to the latest bulletin there are now eleven units successfully operating with a capacity of 10,000 h.p. each. Five more similar units are being installed as rapidly as possible and will be ready for business as it develops. The ultimate capacity of the plant will be 30 such units.

The dam consists of 119 arches and spillways. Each spillway is 30 ft. wide and is closed by a steel gate 11 ft. high and 32 feet long. The dam is 42 feet wide at its base and has an average height of 31 ft. with an additional 21 ft. for the operating bridge. The dam and the bridge are of solid concrete, no reinforcement being used. The piers are spaced 36 ft. centers. The dam is thus approximately 4,300 feet long from the power house to the opposite (Illinois) bank of the river.

An ice fender connects the power house with the west or Iowa side of the river. This structure is made up of a series of concrete slabs, 27 in number, each slab being 9 ft. wide, 15 ft. deep and 70 ft. long. These slabs are supported by piers, also of concrete. There is an opening in this ice fender 300 ft. in length which will be closed during the winter by a timber boom.

As already stated there are ten 10,000 h.p. generators already supplied, with five more being installed. Opposite each generator stands its corresponding 9,000 kv.a. transformer which steps the current up from the generated voltage of 11,000 to the transmission voltage of 110,000. Seventy-four 11,000 volt and twenty-one 110,000 volt oil switches have already been installed. Three large pressure filters have also been installed for filtering the water used in cooling the transformers. The high tension busses and connections are of 1¼ inch and 2 inch iron pipes supported by suspension type insulators.

Two views of the switchboard room are also shown. The switchboards consist of a main bench board for the control of generators, transformers and lines; a battery board; an auxiliary switchboard for the control of two exciter alternators; 15 small panels for the exciters; power switchboards controlling feeders to pumps, cranes, etc.; a lighting switchboard; and a mimic switchboard for the chief operator's use on which the position of all the main switches in the power station is indicated. These switchboards aggregate more than 200 ft. in length. The telephone system also requires two switchboards, one for commercial service, the other for the use of the chief dispatcher.

The 110,000 volt transmission line runs to St. Louis, a distance of 144 miles. The towers are four legged steel structures 79 ft. in total height, measuring 20 x 20 ft. at the base and weighing 6,800 pounds each. Each leg is bolted to a reinforced concrete foundation. The anchor towers are 74 ft. high, 24 x 24 ft. base and weigh 10,500 pounds. The towers carry a double 3-wire transmission circuit arranged in vertical planes 18 feet apart and at an elevation of 50, 60 and 70 feet above the ground. A ground wire for lightning protection purposes is strung along the apex. The wires on the main circuit are composed of 19 strands of hard drawn copper ⅝ inches in diameter and 300,000 c.m. in area. The ground wire is galvanized steel 7 strand cable, ½ inch in diameter.

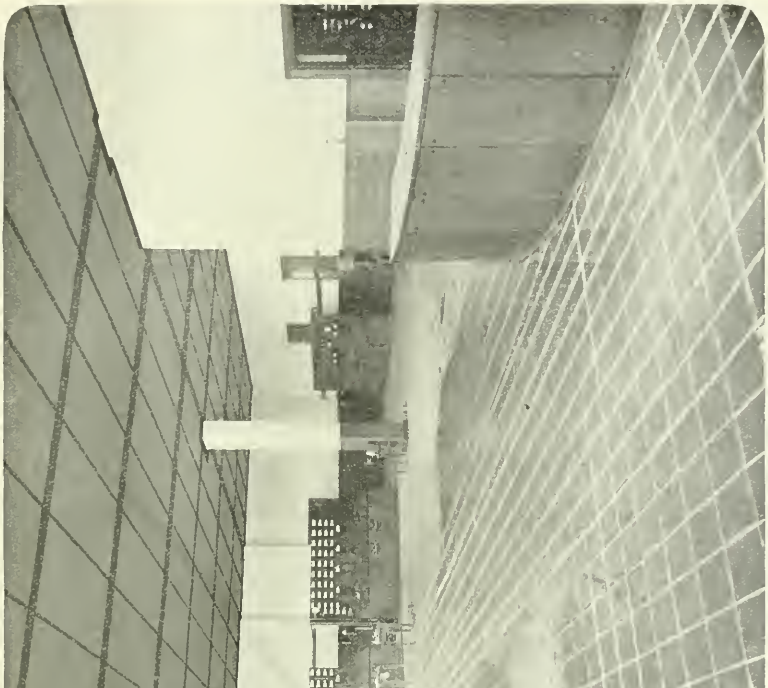
The insulators are of the suspension type consisting of 7 corrugated porcelain discs 10 inches in diameter connected by means of malleable iron fittings cemented to them. The complete insulator unit is 3 ft. in length. For river spans or special high strains insulators composed of 2 to 6 strings of standard units are used.

Branch lines at lower voltages are used to distribute a considerable quantity of the power. One branch operated at 11,000 volts supplies Keokuk and the surrounding towns. Another operated at 30,000 volts supplies about 18,000 h.p. to Hannibel and Quincy. A third operated at 66,000 volts supplies 12,000 h.p. to Alton.

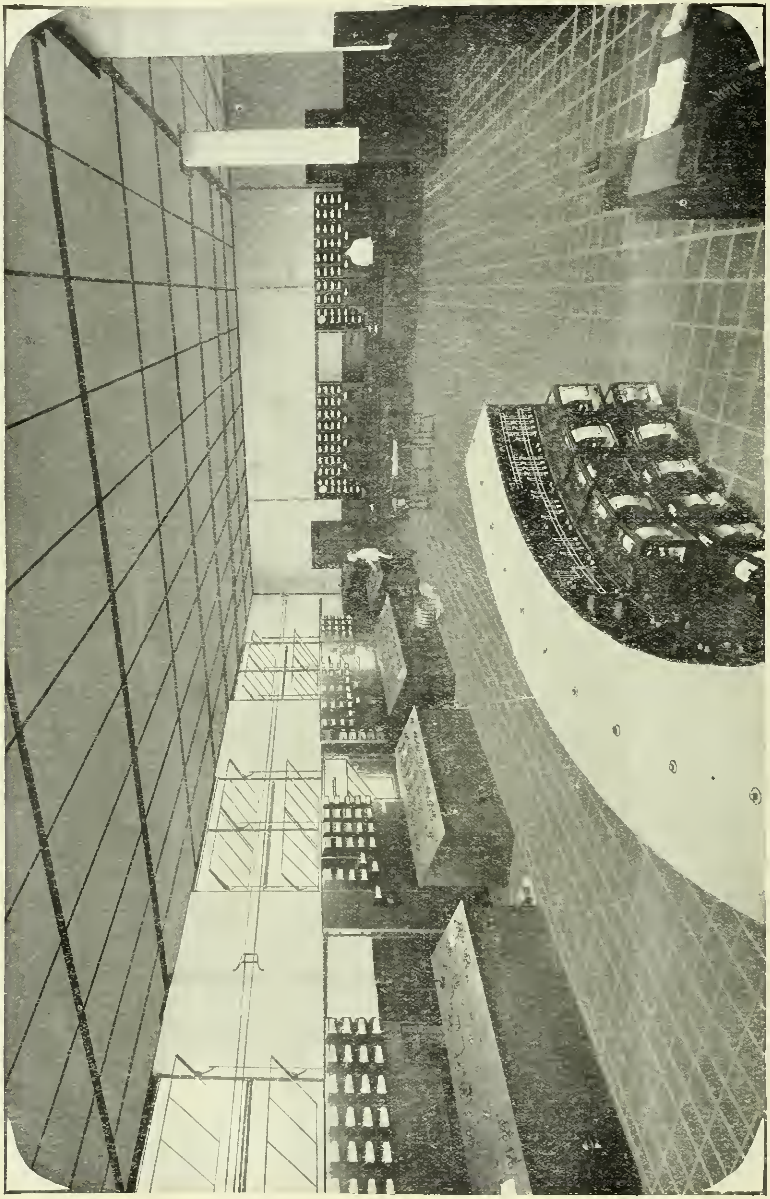
Marconi Wireless

Progress is shown by the report for the year ending January, 1913, of the Marconi Wireless Telegraph Company of Canada, Limited, just issued. Under the new contract with the Canadian Government for the operation of wireless telegraph stations on the Great Lakes, four stations have been established and placed in operation during the past year; one station is at the present time being enlarged, and three other stations are to be built during the current year. The negotiations with the Newfoundland Government were brought to a satisfactory termination by completing a contract which will continue the company's exclusive rights in Newfoundland until the year 1925. Under the agreements with the Newfoundland and Canadian governments the following stations are operated:—ten stations for the Newfoundland Government, the controlling station of which, at Fogo, is the property of the company; twenty-two stations in Eastern Canada and Newfoundland for the Canadian Government, four of which are the property of the company; five stations in the Great Lakes, on behalf of the Canadian government. The number of steamers now operated by the company on its own behalf is forty-four, and in addition four steamers are operated on behalf of affiliated companies. As the old contracts for the equipment of steamships expire, they are being replaced, wherever possible, by new standard contracts, by means of which better conditions are secured to the company. The standard ship contract is for a term of five years.

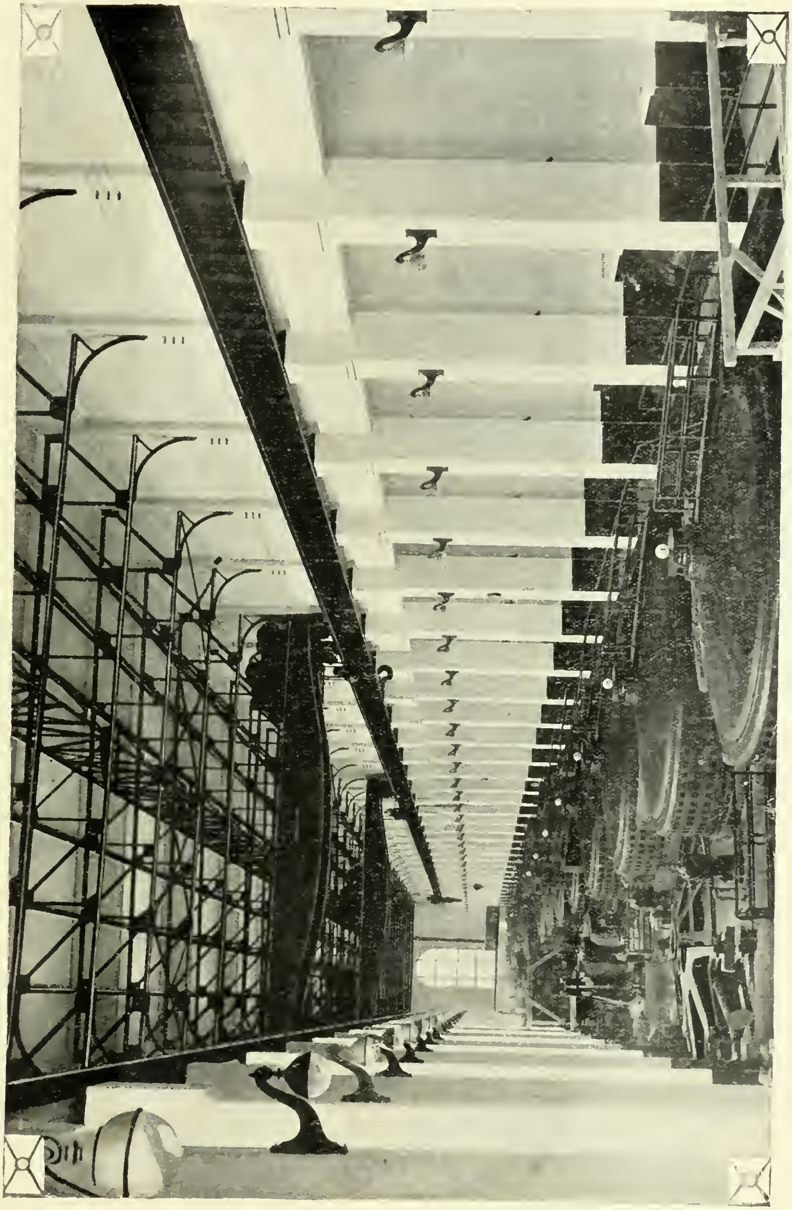
The Trans-Atlantic station at Glace Bay has been operated by the company on its own behalf throughout the year, and recently the construction of the duplex receiving station at Louisburg and the construction of the six-wire pole-line connecting that station with the transmitting station at Glace Bay were completed. The duplex system will be put into operation as soon as its corresponding station, now in course of construction at Clifden, Ireland, has been completed. The directors report that contracts for the sale of apparatus for the equipment of a large number of ship and shore stations are in hand for the current year, all of which will show a satisfactory profit. During the recent session of Parliament the Canadian Government enacted a law making wireless equipment on passenger vessels plying in Canadian waters compulsory. This legislation, which becomes effective on January 1st, 1914, will result in further business for the company, owing to the necessity of equipping about fifteen additional steamers in Canadian territorial waters.



Mississippi River Power Plant, Keokuk, Iowa,—Main Switchboard Room



Mississippi River Power Plant, Keokuk, Iowa.—Main Switchboard Room.



Mississippi River Power Plant, Keokuk, Iowa— Generator room.

Value of Aluminium for Line Conductors

By Mr. E. V, Pannell*

The employment of aluminium wire and strand for overhead transmission has reached an advanced stage of development and the metal has undoubtedly shown that it possesses a wide field of application. The properties of aluminium as compared with copper are now thoroughly well known and it is therefore quite justifiable in a short article of this kind to consider the subject of aluminium "sui generis." Much has been written adopting a critical attitude towards the use of aluminium for overhead transmission in any form, but the experience of such important systems as the Pacific Gas and Electric Company, Pacific Light and Power Company, in California, Kiushiu Hydro-electric Company, Japan, Lake Coleridge Hydro-electric Development, New Zealand, Rjukanfos Company, in Norway, and many others, which have installed aluminium conductors quite recently, is sufficient to demonstrate that the matter is long out of the experimental stage. In all of the cases cited the engineers concerned made a careful study of the properties of the metal before installing it and to this their success is largely due.

In this country practically the whole of the aluminium in use for overhead work has a conductivity equal to 60 per cent. of the Matthiessen Standard for soft copper. This infers a purity of well over 99 per cent. and careful manufacture; both of these conditions are readily met by the producers to-day. In Europe, however, specifications commonly call for a conductivity of 60 per cent. of hard copper which is two per cent. lower than the American standard; it is therefore posible to use in Europe material which is considerably harder than that produced for users in this country. For instance a 14 gauge wire, drawn to a British or German specification, will probably give 29,000 lbs. per square inch on test, whereas it would be difficult to obtain more than 26,000 lbs. on the 60 per cent. conductivity basis. Special methods of rolling are necessary to get the required

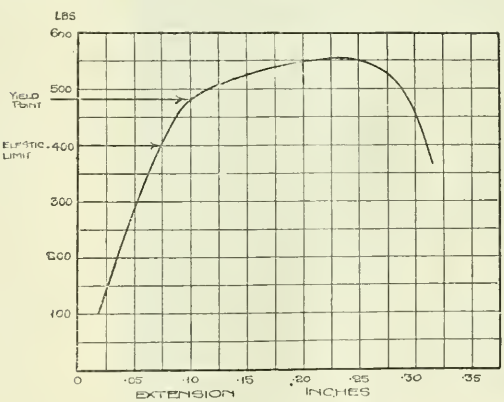


Fig. 1—Load-extension curve for aluminium wire size 24600 cir. mils

tenacity but this is a matter of very slight extra cost which in most circumstances would be well repaid in the improved physical characteristics of the transmission line.

The matter of the elastic limit or the yield-point is of considerably more importance than the ultimate strength and it is only the difficulty of measuring this quantity in a routine test which causes the ultimate strength to be specified in nearly every instance. With copper the ratio of elastic limit to ultimate strength is of the order of 50 per cent. to 60 per cent.; in the case of aluminium however the proportion varies according to the size of the wire from 40 per cent. to as high as 80 per cent. Taking the ordinary guages of wire commonly used in stranded cables the ratio is nearly always about 60 to 70 per cent. The permanent extension of an aluminium wire is from 2 to 3½ times the extension on copper. All of these factors tend to the advantage of aluminium when used as an overhead conductor and give it greater capacity for sustaining abnormal loads without fracture.

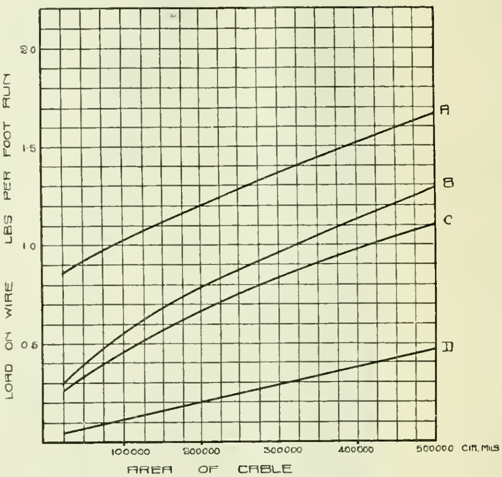


Fig. 2—Loading on overhead aluminium wires: A, With 3/8 in. ice coating and 65 mile wind; B, German Rules, (.127 + .84D); C, British Board of Trade Rules, 25 lbs. wind; D, Weight of wire alone.

The curve shown in Fig. 1 is due to Mr. B. Welbourn, of the British Insulated & Helsby Cables Limited, and shows at a glance the physical characteristics of a sample of aluminium wire as drawn to a European specification.

The maximum permissable working stress in the wire is a subject which greatly influences the success attending the employment of any particular material as a line conductor. In Canada aluminium is usually strung so as to give a maximum working stress under the most severe winter conditions of just below the elastic limit. In Europe on the other hand where, as a rule, short distance pole lines predominate, the conductors are seldom strung to more than one-third or one-half the elastic limit. It is nowadays becoming recognised that a tightly strung line is better practice than one which is slack and that a long sag is likely to give much more trouble than a fairly high tension in the wire; this point is of so much importance that it is well worth sacrificing one or two per cent. on the conductivity if the tenacity of the wire and thereby the tension in the line can be safely increased. As already seen, on European specifications wire of 28,000 to 29,000 lbs. tensile can be employed; this could be produced with an elastic limit of about 18,000 lbs. and strung to take a maximum pull of 16,000 lbs. allowing 3/8 in. ice and a 65-mile wind with quite satisfactory results. The relatively short sag would allow of a short and sub-

* British Aluminium Company.

stantially designed tower of an economical type; the saving on the towers would more than pay for any small extra piece demanded for the special high tenacity material.

Below are tabulated the principal features of the aluminium cables supplied to an important hydro-electric undertaking in Sweden.

Area of cable, cir. mils.	318,000	321,000
No. of strands	19	37
Weight per foot, lbs.	.294	.298
Extension coeff. per degree F.	.0000119	0000115
Specific resistance, microhms per cm³.	2.79	2.82
Resistance coeff. per cent. deg. F.	.222	.222
Conductivity, per cent. Matthiessen standard	57.5	57.0
Breaking stres. cable, lbs. per sq. in.	25,600	31,200
Breaking stress, wire, lbs. per sq. in.	27,300	34,000
Elastic modulus, cable, lbs. per sq. in.	4,350,000	2,670,000
Elastic modulus, cable, lbs. per sq. in.	9,000,000	8,300,000
Extension on 5 in. length, per cent. ..	2.30	1.80

The above are test figures and are throughout somewhat better than the guarantees which were made upon this material. The cables were strung to give a maximum pull of 10,000 lbs. per square inch under severe wind and temperature conditions.

In Germany, where transmission lines are erected under the rules of the German Institute of Electrical Engineers aluminium cables have recently been the subject of considerable attention. The regulations just published make special provision for aluminium, calling for a maximum tension in the wires of 10,000 lbs. per sq. in., figured at 23 deg. with a wind and snow load equal to the expression .127 + .84d lbs. per foot, where d represents the diameter of the cable in inches. This is a simple rule and is characteristic of the European method of reducing variable quantities to a formula wherever possible. As an interesting comparison the maximum permissible load per foot on overhead aluminium wires has been plotted out in Fig. 2 which shows the difference between American, German and British practice in this respect. In England no allowance is made for ice, but the relatively high value of 25 lbs. per square foot of plane surface (15 lbs. on the projected surface of the conductor) is taken for wind pressure. Regarding the vexed question of whether ice forms on aluminium it is generally agreed among European engineers that though ice may not form it is fairly certain that snow will cling to the wire and in some respects is more troublesome. A load of snow falling from an overhead conductor will release considerable of the tension on the latter causing it to snap upwards like a bowstring and possibly make contact with the wire above. In practice on several Norwegian lines it was found that neither ice nor snow gathered on the wires as long as the pressure was on, but only during a shut-down.

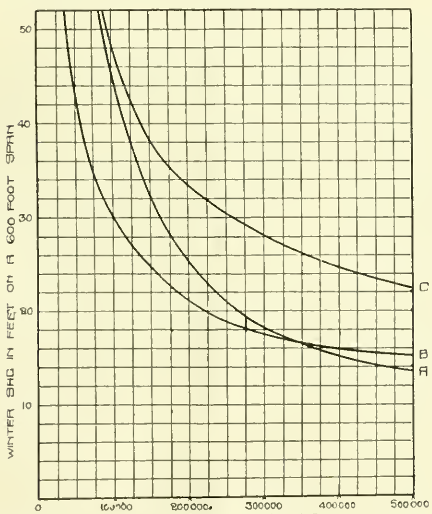


Fig. 3—Sag on overhead aluminium conductors under winter conditions: A, With ⅜ in. ice coating, 65 mile wind and 14000 lbs. per sq. in. maximum pull; B, German Rules (.127 + .84D), 10000 lbs. maximum pull; C, British Rules, 25. lbs. wind, 5600 lbs. maximum pull.

In Fig. 3 the sequel to the last diagram is shown, the sags under winter conditions being plotted for a 600-foot span (the most economical average length). In Great Britain as will be noted the rules are very conservative and this fact has prevented the development of overhead power in that country to any appreciable extent. The new German overhead line regulations however are much more liberal and it is interesting to observe the fact that for the most part the German engineers pull their aluminium lines up tighter than is customary in this country.

The foregoing remarks have expressed the desirability under certain conditions of utilising a special high grade of aluminium wire having extra high tenacity. Although this usually necessitates the reduction of 1 or 2 per cent. in the conductivity requirements this is a matter of far less moment and it would be well worth while for engineers when calling for tenders to give the manufacturer the option of putting in a material of superior physical characteristics but slightly higher resistance and to estimate what overall economy would be effected by the use of such metal.

Winnipeg's New Line

The type of transmission line recommended by the consulting engineers and which will be adopted by the Light and Power Department for the duplicate system is a combination of braced and flexible towers, with approximately twelve flexibles between each two, braced and spaced 400 feet apart, thus placing a braced tower at each mile. The type of tower to be used will not be decided upon until the tenders are in.

Tenderers will be asked to submit alternative bids and the type adopted will depend largely upon the result of specified tests. Tenders for the towers will not be called till spring but contractors will shortly be asked to tender upon the work of piling and other labor in connection with the preparation of the right of way. This tower line is to be erected along the right of way of the present 60,000 volt line which is approximately 75 miles long and will be designed to carry two 110,000-volt lines with suspension type insulators.

Personal

Mr. A. E. Grant, managing director of the Canadian British Insulated Company, Limited, Montreal, is on a visit to the West, going as far as Vancouver.

Mr. J. H. Bunting, joint manager of Bruce, Peebles & Company, electrical engineers, Scotland, has been on a short business visit to Montreal, returning home via New York.

M. J. F. Madden, manager of the Winnipeg branch of the Canadian General Electric Company, recently sustained a compound fracture to the right leg in an automobile accident.

Mr. Geo. D. Leacock, Canadian Moloney Electric Company, Toronto, will be married on November 20th, in Bloor Street Presbyterian Church, to Miss F. O. Powis, also of Toronto.

Testing of Telephone and Telegraph Lines

By Mr. T. H. Nicholson

The Voltmeter Shunt Coil

It often happens that the resistance of a voltmeter is not given in round numbers and as a result it is difficult to use the above formula mentally. For this reason as well as for others explained later, a shunt coil is used to reduce the resistance of the measuring equipment to a figure easily calculated. This does not affect the tests, or the accuracy of them, providing the testing battery is adjusted to give a full scale deflection on short circuits, with the shunt coil in use, in a manner exactly similar to that followed with an unshunted voltmeter.

For example, Fig. 12 shows a voltmeter having a resistance of 1655 ohms; as such a number is cumbersome in making calculations it simplifies matters materially if we reduce this resistance to 1000 ohms by the insertion of a parallel or shunt resistance, X. The value of X is obtained from the standard formula

$$\frac{1}{1000} = \frac{1}{1655} + \frac{1}{X}$$

from which X works out to approximately 2527 ohms, which number is close enough for practical purposes.

We now have a voltmeter arrangement which for all practical purposes is similar to a voltmeter having an internal resistance of 1000 ohms as shown in Figs. 10 and 11. The value of the external resistance A is therefore found from the formula already given

$$A = \frac{D}{d} V - V$$

$$= \frac{D}{d} 1000 - 1000$$

Where D and d are, as before, the needle deflections, respectively, before and after the external resistance A is inserted. This formula is perhaps more easily carried in the

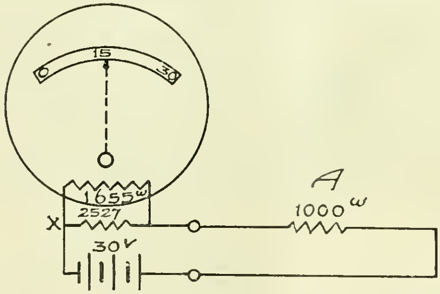


Fig. 12

form (D/d — 1) 1000 and may be conveniently explained as follows:—divide the voltmeter scale by the deflection, subtract one, and multiply by 1000.

Some wire chiefs like to be able to measure resistance smaller than can be determined with accuracy with a 1000 ohm voltmeter and for this purpose use a 100 ohm arrangement. This is accomplished in the same manner as with the 1000 ohm circuit and, if so desired, a voltmeter can be arranged for use with either. The method adopted is shown in Fig. 13, where the same voltmeter as shown in Fig. 12 is assumed only, in addition to the 2527 ohm shunt coil X, an additional coil Y is provided and adjusted to give, with the voltmeter resistance of 1655 ohms, a joint resistance of 100 ohms. In this case Y works out to approximately 106 ohms. Where the resistance A is very small, as shown in Fig. 13, the deflection of the needle, using the 1000 ohm circuit, would be somewhere between 29 and 30, but its position would be difficult to determine accurately. If its position were taken as 29 the value of A would work out about 34. With the 100 ohm circuit, however, the deflection would be exactly 29 and the resistance would work out at 3.4 ohms.

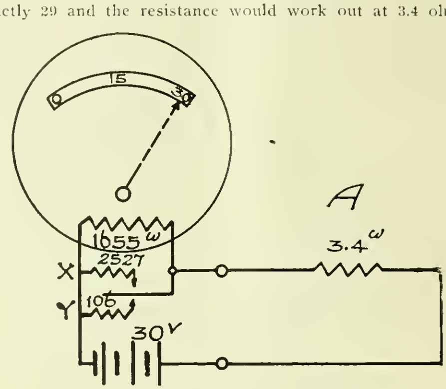


Fig. 13

These points amphasize the fact that this type of instrument has its limitations where the resistance to be measured are small.

Care must be taken with the use of a 100 ohm shunt, or for that matter with any shunt, to avoid keeping it in circuit any longer than is absolutely necessary to observe the deflection. This is for the reason that it will run down the testing battery rapidly, and so make the results misleading. Then again, it must be remembered that a greater voltage is sent out on the line when a shunt coil is in use, so care is necessary to avoid giving trouble-men disagreeable shocks.

Another valuable feature of the shunt coil is to give uniform readings on all of a group of voltmeters on a large test board, so that a tester will know that each instrument will indicate the same whether it is his own position or not. This makes it possible to have a table made up for common use showing the various reading values for any shunt that the voltmeters are equipped with. The following table gives the resistances as indicated on any 30 volt instrument using a 1000 ohm circuit as shown in Fig. 12:—

Tables of resistances as indicated by a 30 voltmeter, using a shunt coil giving 1000 ohm circuit.

D	R	D	R	D	R
1	29,000	11	1,727	21	428.6
2	14,000	12	1,500	22	363.6
3	9,000	13	1,308	23	304.3
4	6,500	14	1,143	24	250
5	5,000	15	1,000	25	200
6	4,000	16	875	26	154
7	3,286	17	764.7	27	111
8	2,750	18	666.7	28	71.1
9	2,333	19	578.9	29	34.5
10	2,000	20	500	30	0

D = deflection. R = resistance indicated.

(To be continued)

Electric Railways

Street Railway Depreciation

The printed report on the valuation of the Toronto Railway Company's system contains some interesting figures with regard to depreciation of the various equipments. While this is not given in detail in certain instances, definite figures are given however of the electrical distribution system and of the power plant equipment. The figures given under these two headings are as follows:—

Electrical Distribution System

	Years' Life	Depreciation Per Year
Iron poles	35-40	3 to 2½
Cedar poles	20	5
Pole brackets	25	4
Cross arms—wood	20	5
Cross arms—iron	30	3 1-3
Weatherproof cables	30	3 1-3
Lead cables	35	3
Transmission line material	20	5

The depreciation of the power plant equipment was based both on the number of years the equipment had been installed and the manner in which it had been maintained. The rates of depreciation generally applied are enumerated below:—

Power Plant Equipment

Machinery foundations:

These are depreciated at the same rate as the machinery which they support.

Coal handling apparatus ... 6 per cent.

Grates and stokers:

Maximum ... 50 per cent.

This item is depreciated 10 per cent. per year for 5 years, and no further depreciation is applied if they are in use.

Boilers and settings:

- Horizontal tubular boilers ... 8 per cent.
- Water tubular boilers ... 3½ per cent.
- Steel smoke breeching ... 10 per cent.

Stacks:

- Brick and concrete ... 3 per cent.

Heaters:

- Open heaters ... 3 per cent.
- Closed heaters ... 6 per cent.
- Closed cast iron heaters ... 4 per cent.
- Pumps ... 5 per cent.
- Air compressors ... 5 per cent.

Engines:

- Corliss, slow speed ... 3 per cent.
- Automatic, high speed ... 5 to 8 per cent.
- Piping and covering ... 3½ per cent.

Generators and transformers:

- Slow speed ... 4 per cent.
- High speed ... 5 per cent.
- Transformers ... 5 per cent.
- Rotary converters ... 5 per cent.
- Switchboards, generator leads and wiring ... 3 per cent.

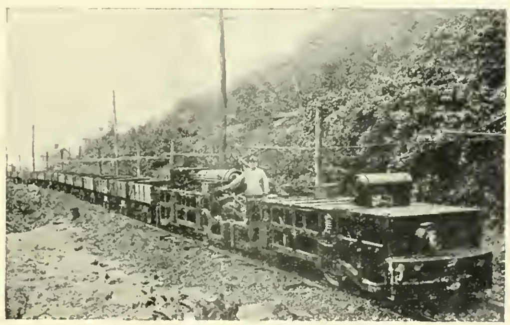
The substructure of the track was depreciated on a basis of 4 per cent. per annum. The life of the rail itself was considered to be the period of time required for the head of the rail to wear away to a remaining height of 5/8 inches above the tram or the base of the groove, the difference between this height and the height of the head above the tram at any time constituting the remaining wearing life of the rail. Measurements were taken at frequent intervals along the track with a specially constructed vernier measuring device, by which means the actual distance between the head of the rail and the tram was obtained in 64ths of an inch. From this determined height there was deducted the scrap height of 40-64 inches, the remainder representing the wearing height of the rail.

Car bodies in all cases were depreciated according to a life of 20 years for continuous service or, with a partial steel under-frame, a life of 25 years. The life of car bodies used only during summer and winter was taken as 25 years. The truck and motor equipment were depreciated by inspection.

The Largest Mine Locomotive Ever Built

The Carnegie Coal Company have recently installed at the Charleroi (Pa.) Coal Works two of the largest mine locomotives ever built. These locomotives weigh 30 tons apiece and are of the Baldwin-Westinghouse "Barsteel" type. It is estimated that each locomotive can haul 100 cars each loaded with three tons of coal over the local grades.

The reasons for using such large locomotives are as follows:—the Carnegie Company recently acquired possession of the Charleroi mine, which is of considerable size and is well developed. A large production is desired from it, but the haul is about two miles long with the grade largely against the load. Hence the average haulage locomotive of from 15 to 25 tons would not be sufficiently large to keep production up to the estimated tonnage.



Two 15-ton locomotives operated in tandem

The locomotives installed possesses a number of interesting features. Each locomotive consists of two separate

units which can be separated and used as two 15-ton locomotives if desired. This use of two units in tandem is advantageous in such large machines because the weight is distributed over eight wheels instead of four and hence the locomotive has great tractive power and is also easier on the track than if the weight were more concentrated.

The "barsteel" construction represents the most modern type of design. As is clearly seen in the illustrations, the frames are not built up of plates but are formed of a grid of steel bars of heavy cross-section. The side frame of each unit is cast separately forming an extremely strong and rigid construction. The openings in the frame give ready access for inspecting, oiling, replacing brake shoes, adjusting brake rigging, etc., and also provide thorough ventilation to the electrical apparatus so that its all-day efficiency is higher than would be the case if the frame were totally enclosing. This type of frame has been in use for many years for large freight locomotives but has been only recently adapted for mine locomotives.

Air brakes are used owing to the greater ease of handling so large an engine but each unit is equipped with hand brakes which can be operated together from the operating stand of the leading unit. An auxiliary reservoir is provided on the trailing unit, the main reservoir and compressor being located on the leading unit. The hand brakes are operative on both units when disconnected for independent operation. The controller for the tandem is of the individual magnetic blowout type and handles all four motors at once. When the tandem is split, the four-motor controller handles the two motors of its unit without change in connections while the other unit has its own two-motor controller.

New Cars for Montreal Tramways

As already noted in these columns the Montreal Street Railway Company will shortly place in operation 25 motor cars and 25 trailers for train operation on St. Catherine Street, Montreal. The cars are being supplied by the J. G. Brill Company. St. Catherine street is the trunk line of the Montreal system and conditions for train operation are favorable in-as-much as the traffic is generally heavy enough to justify operating two-car trains throughout the whole day. Hence neither the time lost in making up trains nor low trailer mileage will enter into the question.

It was pointed out in our previous issue that one of the important operating features of the new service will be that all of the loading and most of the unloading will take place at the centre of the train. This is accomplished by constructing the trailer with entrance and exit both at the front end only. These two-car trains will practically constitute an articulated unit with two entrances and two exits at the centre of the train and one exit at the front end of the motor car.

The new motor car will have longitudinal seats in the half which is nearest the loading platform. The vestibule closing with folding doors will make it possible to do away with all body doors and all end bulkheads. Folding steps will also be used in connection with the doors. The seating plan and the door and step arrangement of the trailer are similar to those of the motor car as shown in the figure herewith, except that the trailer is provided with circular seat at the rear. The rear platform of the motor car and the front platform of the trailer are practically duplicates in the arrangement of the dividing rail, conductor's stand, aisle widths etc. The platforms are 5 feet 9 inches long. It will be observed that means for both exit and entrance are provided on the loading platforms in addition to the customary sliding door exit on the motorman's platform. An important feature will be the wiring of all doors in series so that the motorman will not receive the light signal for starting until every door in the car is closed.

Each motor car will be equipped with four 50 h.p. motors, commutating pole type. The trucks will have 30-inch diameter wheels with step heights as follows:—from gronnd to first step 16 inches, from first step to platform 12 inches and from platform to car floor 8 inches.

Steel Gas-Electric Motor Cars

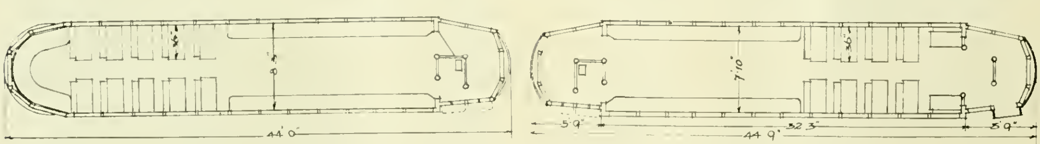
One of three gas-electric motor cars, built by the Wason Manufacturing Company for the Midland Valley Railroad Company, has recently been placed in operation for supplementary service on the company's main line between Wichita and Arkansas City, Kansas. The railroad's complete system extends from Wichita through Muskogee, Oklahoma, to Hoye, Arkansas, and, including numerous branches, embraces a total of 365 miles. The new car makes one round trip a day over a distance of 102 miles at a scheduled speed of 18.5 miles an hour.

The cars have all-steel frames, consisting of I-beams and channels, with side sheathing of steel plates. The nnderfloor is of wood with heavy felt lining between it and the car floor. There is also a felt interlining to the car sides. On either side of the centre, separating the passenger and smoking compartments, is an entrance with three inside steps leading to the car floor. There is also an entrance at the rear leading from the open platform.

The cars are of the General Electric Company's standard combination passenger, smoking and baggage compartment type, and are handsomely finished in mahogany, with plate glass windows. The transverse seats are of sufficient length to accommodate three persons and are upholstered with plush in the passenger compartment and with Spanish leather in the smoking room. The total seating capacity is 86 persons.

The generating unit consists of an eight-cylinder, four-cycle gas engine, direct connected to a 600-volt commutating pole electric generator designed to meet the special conditions demanded by the service. The engine is started by compressed air from the main reservoirs of the air brake system, which are built with surplus capacity for this purpose. The engine can rotate at normal speed and deliver its maximum power irrespective of the speed of the car, which is of great advantage on grades and in emergencies. There is also an auxiliary equipment consisting of a two-cylinder, four-cycle gas engine, direct connected to a single-cylinder air compressor and lighting generator. Two 600-volt railway motors of 100 horse-power each are mounted on the axle of the forward truck.

The Steel City Electric Company, Pittsburgh, announce the appointment of the Ohio Distributing Company, Hearst Building, Chicago, as their sales representative in the Central Western States, effective November 1st, their previous contract with the I. A. Bennett Company having expired.



Sectional plan of one of 25 new cars to be operated by the Montreal Tramways Co.

Use of Higher D. C. Voltages

By Mr. G. H. Hill*

The fact that 1,200 volts and higher direct current potentials are used on more than nineteen hundred miles of electric roalroads in this country, furnishes in itself convincing evidence of the success of this application with respect to initial cost, reliability and low costs of maintenance.

Several years of operation has fully demonstrated the ability of the apparatus to withstand the most severe service without "nursing," and with most satisfactory economic results. In fact results have surpassed expectations in many respects, and it is conservative to state that 1200 volt apparatus costs no more to operate than 600 volt apparatus.

Reports of remarkable endurance and reliability, including every feature from power house to rolling stock, have been the rule. Coming from unprejudiced, practical operators and supported by a formidable array of statistics there is no room for skepticism. Records show that with 90 per cent. of the available equipment in hard and continuous service, cars have averaged over 250,000 miles without renewing any motor brushes or bearings, control contacts, or similar parts. The generating apparatus has run continuously for months without interruptions or renewals of parts, and has endured heavy overloads for long periods without distress. Inspection and maintenance crews have been reduced to a minimum unusual with even the best known practice.

To those who are not familiar with the details of the apparatus used with the higher voltages these results undoubtedly appear remarkable, since we are accustomed to expect a period of development, and more or less experimenting, with new methods and systems.

The idea that the application of higher d.c. voltages constitutes a "system" differing from 600 volts was perhaps natural, inasmuch as the initial application came at a time when much was being said about "systems," the single-phase system especially being much discussed.

No New System Involved

Properly considered, the use of the higher d.c. voltages does not involve a new "system." It is simply a logical advance along established lines, wherein not a single good element is discarded or replaced. The necessity for a higher distribution voltage than 600 was generally recognized as soon as electric interurban and heavy freight railways became economically possible. The operating voltage had been increased from 500 to 600 and 700 volts in many instances, and the increase to 1200 was a natural step as soon as the improvements in generators, motors and control apparatus made this commercially possible. The one improvement that permitted this step in advance was the successful application of the old idea of commutating poles to motors and generators. With a full understanding of the commutation problem, the proper application of an intermediate flux to neutralize armature reaction removed the chief limitation in electrical design, and made the problem of higher voltage one of insulation and the perfection of auxiliary details.

A short experience with 1200 volt apparatus indicated the feasibility of still higher potentials and led at once to the use of 1500 and 2400 volts, where such voltages were economically desirable. By regarding these higher voltages for railways as the natural development and extension of the existing standard system, unnecessary mystery and incredulity attendant on new systems disappears.

A brief analysis of the elements of 1200, 1500 and 2400 volt apparatus will support this point of view by exhibiting their simplicity and the absence of untried or doubtful features, and may as well be of interest as indicating the solutions of some of the attendant detail problems.

With any d.c. voltage the usual and desirable three phase generation and transmission are applicable, so this need not be considered when making comparison with 600 volts. The great importance of a balanced polyphase transmission, capable of tying in with any standard power system and free from disturbing inductive influence on other neighboring circuits, is being more and more recognized and can not be over estimated. The elements more or less affected by the higher voltages are the substation apparatus, the distribution conductors and the rolling stock.

The conversion of alternating current to direct current may be made, as with 600 volts, by rotary converters or motor-generator sets. With 25 cycle transmission it is usual to employ rotary converters for 1200 or 1500 volts. These may be single units where there is no need for power at half voltage. Where such half voltage is desired for city running or to supply existing equipment, two converters are connected in series.

Single unit converters of 1200 or 1500 volts are provided with commutating poles to neutralize armature reaction and provide good commutation with the necessarily increased volts per bar, as compared with 600 volt machines. They are started from the a.c. side by ½ or 2-3 voltage taps as usual. The use of commutating poles makes it desirable to lift the brushes from the commutators during the starting period to avoid the sparking set up by the leakage flux through the unexcited commutating poles. By a simple mechanical arrangement all brushes but two are raised by a single lever, and a semaphore at the top of the field frame is lifted to clearly indicate the fact to the switchboard attendant. The two brushes not lifted are special narrow pilot-brushes and are left in contact to excite the shunt fields. The use of commutating poles on converters gave such satisfactory results that they have been introduced on all large 600 volt machines, and are being applied in numerous cases to small 600 volt units. Likewise the brush lifting device has been received as an inherent improvement, quite aside from the initial purpose, and has created a general demand for such an arrangement on account of the convenience it affords in caring for the commutator.

Where 60 cycle transmission is employed, two converters in series may be used for 1200 volts.

High voltage generators reliable

The inherent limitations of design, namely, volts per bar, peripheral speed of commutator, and permissible minimum width of bar, combine to place the limit of possible voltage at about this point. Sixty cycle transmissions are frequently extensive and contain a large proportion of inductive load. For this reason the more stable synchronous motor-generator set is usually employed, especially when control of power-factor is a desideratum. The generator of such a set, wound for 1200 or 1500 volts, with a single commutator, is similar to a 600 volt generator with the addition of a compensating winding as well as the commutating poles. This compensating winding consists of a number of series turns through the face of the exciting field pole, to supplement the action of the commutating poles and completely neutralize the armature reaction. Such machines properly designed are fully equal to the best 600 volt designs as to commutation and reliability, and are superior to them in ability to handle heavy overloads.

For 2400 volts the three unit set is employed, having two 1200 volt generators connected in series and driven by a single synchronous motor. For the excitation of the synchronous motor a direct current exciter of low voltage is usually directly connected to the set. It is economical in space and cost to supply the shunt field of the generator also from this exciter, although, if wide control of power-

* Elec. Ry. Dept. General Electric Co.

factor on the synchronous motor is desired, it is better to have two direct connected exciters, one for the motor and one for the generators.

The transformers which supply the rotary converters or motor-generator sets have practically no features different from the standard low voltage apparatus. The secondary voltage is approximately double for a single unit, or two secondary windings are provided, each giving half voltage where two converters are connected in series.

The switchboard for the a-c. circuits does not differ from low voltage apparatus. For the direct current panels the difference consists in improved circuit breakers for handling the higher voltage arcs, and in isolating these devices more effectually and insulating all live parts from contact with the operator. The circuit breaker and main switch for 1200 and 1500 volts are placed high on the panel and connected to operating handles by wooden rods at the back of the panel. For 2400 volts these parts are separately mounted over, and back of, the panel.

The meters, voltmeter jacks and all live parts are thoroughly covered and insulated. As an additional precaution against leakage currents through any metallic seams that may be in the slate, all conductors which pass through the panel are bushed with porcelain.

Distribution Conductors

The trolley and distribution feeders differ only in the use of somewhat better insulation. The introduction of wooden strain insulators in cross-spans, guys and pulloffs, in addition to the standard 600 volt appliances, has been found ample. Incidental with the development of heavy interurban projects and heavy freight electrifications made feasible by the higher voltages, marked improvements have been made in the trolley construction. The ordinary direct suspended trolley wire and wheel collector are unsuited to heavy and fast traffic, because of:

First. Insufficient resilience due to the rigidity of the wire supports and the inertia of the trolley wheel

Second. Insufficient collecting capacity.

Third. Inconvenience of reversing the trolley pole and keeping it on the wire.

These are overcome by use of the catenary suspension with hangers permitting a vertical movement of the conductor and the elimination of all heavy fittings at crossovers, switches, etc. This produces a perfectly flexible conductor free at all points to yield to the upward pressure of the collector, and effectually solves the problem of high speed operation, at the same time permitting the use of a heavier collector with greater upward pressure. Instead of a trolley pole and wheel a pantograph with wide roller is used, which may be run in either direction and raised or lowered pneumatically by the motorman. This combination can successfully collect from two to three times as much current as the older types, and is suitable for the heaviest freight or highest speed passenger locomotive.

Third rail collection on 1200 volts has been in successful operation for several years, and has been found entirely feasible in test for 2400 volts. The under running type of rail is used, the rail being smaller and the insulators larger than for 600 volts. Wooden protection over the rail is provided and is effectually insulated from the rail by porcelain supports.

Rolling Stock

The series-parallel connection of motors with or without field weakening is used as with 600 volts. For operation on a 1200 volt line the motors may be wound for 600 volts each, and insulated for 1200, or may be wound and insulated for 1200 volts. The first arrangement permits operation on 600 volt connecting lines at full speed; the second provides series-parallel control with two motor equipments. It is not economical in design to build motors for 1200 volts each smaller than about 125 h.p., and as most interurban road operators prefer four motor equipments requiring not over 100 h.p. per motor, the usual selection is the first alternative. For 2400 volt lines the motors are wound for 1200. As 2400 volt installations chiefly require haulage by locomotive and a limited number of heavy passenger cars, the motors are large enough for economical design at this voltage. In every case the motors lend themselves mechanically and electrically to the best modern practice. Low armature speeds, large air gap, ample bearing surfaces, full ventilation with self-contained fan, heat proof insulation, and all the other well-known desirable features of the perfected railway motor are embodied in the high voltage designs. Likewise the control retains its simple rugged contactor with improved magnetic blowout and insulation. The contactors are assembled in sheet iron boxes which are thoroughly grounded as with the lower voltages. The secondary circuits are the same as for 600 volts and are operated direct from the trolley when the car is on a division with this voltage. When on the high voltage trolley the control current is derived from a small auxiliary dynamotor or motor-generator set.

For 1200 or 1500 volt motor cars the dynamotor is used, it is lighter and more compact. This rynamotor consists of an armature with double windings and two commutators with a single field. The two armature windings are in series across the line, and the half voltage for the auxiliary circuits is obtained from a tap between the armatures. The device is simple and reliable, and requires little attention. The bearings have light duty, as there is practically no mechanical torque on the shaft.

The master controller, control couplers and jumpers are exactly the same for the high voltage as for the low, and the control can be made for automatic or hand control as desired.

For the smaller size of 1200 or 1500 volt equipments the ordinary platform controller can be provided. This makes available the very simplest form of equipment. These cylinder controllers are built along the same line as for 600 volts, but with the improved magnetic blowout and with greater space and insulation for the isolation of the arcs. The insulation in the controller is made ample so that the frame of the controller may be grounded, which is the only thorough manner of protecting the motorman. For locomotives, the Type M control is used, and instead of the dynamotor a small generator provides current for the auxiliary circuits at low voltage. This small generator is driven by the same motor that drives the ventilating fan. As a ventilating fan is always furnished with the locomotive, in order to give the locomotive motors the highest possible continuous rating, the addition of a small generator adds practically no complications.

Auxiliary Circuits

The auxiliary circuits outside of the control, viz., air compressor motor, the lights for motor cars, and the heaters for motor cars and locomotives, required more or less special development. The simplest arrangement, which was adopted on the first high voltage cars, was the use of standard 600 volt lights, car heaters and air compressors supplied with low voltage current from the dynamotor. This, however, makes the dynamotor of considerably greater capacity and weight, and is, from an engineering point of view, unnecessarily indirect. The design of 1200 volt car heaters was not a serious matter, it being necessary chiefly to provide against foreign objects coming in contact with the live parts, and at the same time not restrict the free circulation of air. Various plans have been suggested and tried for the air compressor. One method is to connect a 600 volt compressor across the high armature of the dynamotor and the other auxiliaries across the low dynamotor armature. This tends

to reduce the required size of the dynamotor, and if the loads on the high and low circuits are fairly well balanced, is a satisfactory arrangement. Another scheme provided for a combination dynamotor-compressor in which the dynamotor was connected to the air compressor by a clutch. The disadvantage of this is the inherent unsuitability of the dynamotor to do mechanical work. When acting as a dynamotor there is no torque on the shafts and no armature reaction, but when it is coupled to the compressor, and is called upon to do mechanical work through the shaft, the device becomes more motor than generator, and the result of armature reaction causes sparking at the brushes. This cannot be corrected properly in the designing, since the same armature may be called upon to be a generator at one time and a motor at another. The most satisfactory arrangement for the air compressor is to keep it independent of other circuits and provide it with a high voltage motor. It is found that a 1200 volt motor of this size can be built with very excellent characteristics. A very satisfactory arrangement consists in having two motors on the compressor, one on each side. On 1200 volts these two motors are connected in parallel and for 2400 volts they are connected in series. If the equipment is to operate on 600 and 1200 volts, the two small motors are each wound for 600 volts, so that full compressor speed may be obtained both on high and low voltage.

In many cases the amount of current required for car lighting is small enough to make it desirable to supply the lights from the dynamotor, but if there are a large number of lights, and if a large headlight is desired, it is desirable to remove these circuits from the dynamotor. Experiments show that it is not safe to connect a sufficient number of the ordinary car lights in series across 1200 volts. The reason for this is that the contacts and leading-in wires of the sockets on the standard 600 volt lamp are close enough together so that the breaking of a filament in one lamp on the 1200 volt circuit might hold the arc across the leading-in wires of the lamp, which would continue to burn until it destroyed the lamp base and socket, and this might possibly become a fire menace. Accordingly a new design of socket and lamp was necessary. This has been produced, and is somewhat similar to the parts used for series street lighting. With this new socket either six 200-volt lamps or twelve 100-volt lamps may be used in series. The lamps and lamp sockets are installed in iron receptacles and the wiring is placed in iron conduit. The receptacle for the socket is designed to cover the lamp base and all live parts and is thoroughly grounded. This gives very thorough protection to persons handling the lamps. The switches for the heater circuits and for the lamp circuits are thoroughly enclosed and protected. The usual arc headlight on 1200 volts necessitates consuming a large amount of energy in resistance. Experiments with incandescent lamp headlights have shown that, with a properly made parabolic reflector, a lamp with a small centralized filament, which can be accurately focused in the reflector, makes a very excellent headlight and is much more economical than the arc headlight. This incandescent headlight may be placed in series with the car lights or even in series with a certain amount of resistance, as the high efficiency tungsten filament is used and the current is much less than for the arc light.

The lights for locomotives on either 1200 or 2400 volts require but little energy and this is best furnished from the low voltage generator.

Car equipments for 2400 volts are provided with a small motor-generator set to supply the low voltage auxiliary circuits. In some instances on either 600, 1200 or 2400 volts, operators have considered the lighting question important enough to warrant an arrangement which will provide very steady voltage on the lighting circuit, and also one that will

Lines in the United States using 1200 volts and upwards

ROAD	Permanent Way Length of Route	Overhead Construction Trolley or Third Rail: Type	Voltage	Transmission Line: Voltage	Frequency	Phases
Indianapolis & Louisville Traction Ry. Co., Scottsburg, Ind.	41	Direct Suspension	1200	. . .	.	3
Central California Traction Co., Stockton, California.	69	Catenary and Third Rail	1200	60000	60	3
Pittsburg, Harmony, Butler & New Castle Ry., Eidenau, Pa.	65	Direct Sus., Double Trolley	1200	13200	60	3
Washington, Baltimore & Annapolis Elect. Ry., Baltimore, Md	60.6	11 Point Catenary	1300	33000	25	3
Milwaukee Flectric Wailway & Light Co., Milwaukee, Wis.	135	Catenary	1200	13200 38000	25	3
Aroostook Valley Railway Company, Presque Isle, Me.	32	Direct Suspension	1200	11000	60	3
Oakland, Antioch & Eastern Ry., San Francisco, Cal.	100	Catenary	1200	11000	60	3
Southern Cambria Railway Company, Johnstown, Pa.	23	Direct Sus., Dougle Trolley	1200	. . . . .	. .	
Shore Line Electric Railway Company, Saybrook, Conn.	74	Bracket Catenary	1200	11000	25	3
Southern Pacific (Oakland, Alameda & Berkeley Div.), Cal.	81	Catenary	1200	13200	25	3
Ft. Dodge, Des Moines & Southern Railway, Boone, Iowa.	120	Direct Suspension	1200	22000	25	3
Southwestern Traction & Power Co., New Iberia, La.	12.5	Catenary	1200	. . . . .	.	
Oregon Electric Railway, Portland, Oregon	154	Catenary	1200	60000	33	3
Davenport & Muscatine Railway Co., Davenport, Ia.	30	Catenary	1200	33000 Y	60	3
Kansas City, Clay County & St. Joseph Ry., Kansas City, Mo.	72	Catenary	1200	33000	25	3
Nashville, Gallatin Interurban Railway, Nashville, Tenn.	27	Direct Suspension	1200	33000 Y	25	3
Piedmont Traction Company (Couth Pr. Co.), Charlotte, N.C.	130	Catenary	1500	100000 and 50000	60	3
Butte, Anaconda & Pacific Railway, Butte, Mont.	30	Catenary	2400	. . . . .	. .	
United Railway Company, Portland, Oregon	28	Catenary	1200	60000	33	3
Southern Traction Company, Dallas, Texas	158	11 Point Catenary	1200	33000	60	3
Pittsburg & Butler Railway Company, Pittsburg, Pa.	33	Catenary	1200	22000	25	3
Pacific Elect. (San Bernardino Div.), Los Angeles, Cal.	57	Catenary	1200	60000	50	3
Tidewater Southern R.R., Stockton, Cal.	40	Catenary	1200	104000	60	3
Portland, Eugene & Eastern Railway Co., Portland, Oregon.	95	Catenary	1500	13200	60	3
Southern Illinois Railway & Power Co., Harrisburg, Ill.	17	5 Point Catenary	1200	33000	60	3
Jefferson County Traction Company (Eastern Texas Electric Co. S. & W.), Beaumont, Texas	20	Catenary	1200	. . . . .	. .	
St. Paul Southern Electric Railway, St. Paul, Minn.	18	Catenary	1200	33000	60	3
Michigan United Traction Company, Jackson, Mich.	92	Third Rail and Direct Suspen.	2400	140000	30	3
	150	Trolley	1200	40000	60	3

provide lights in case power is cut off at crossings or for any other reason. Such an arrangement consists of a storage battery with small motor-generator, the motor being fed from the line and the generator floating across the storage battery. When this arrangement is used the lights are usually wired on 125 volt circuit.

For lighting waiting rooms along the railroad on 1200 or 1500 volts, series lamps fed from the trolley are used. For voltages of 2400 or higher it is desirable to feed such lighting circuits separately from the a-c. transmission.

Higher voltage direct current for railways is not to be considered as superseding 600 volts. The voltage to be used in any case depends upon the character of the service and the conditions to be met. For congested service having a large number of small equipments the 600 volt system is undoubtedly the most economical in every way. For interurban lines having heavier equipment operating on longer headway, and with light freight service, 1200 or 1500 volts is most economical, while for heavy trunk line electrification 2400 volts is required. There undoubtedly will be cases where higher potentials than 2400 volts will be advantageous, and there is no reason why apparatus cannot be designed for higher direct current potentials than 2400 volts. In fact, it seems entirely feasible to carry this development successfully to say 5000 volts. This voltage will undoubtedly take care of any train movement that exists on even the heaviest grade sections of trunk railways.

Electric Brakes

One of the requirements of heavy grade work is a means for electrically braking the train, and this ability has been one of the principal advantages of the polyphase a-c. system. It has been found, however, that the direct current locomotive can be provided with regenerative control which is very simple, feasible and practical. The addition of this valuable element to the direct current locomotive places the direct current system in the enviable position of meeting all conditions with apparatus throughout of well-known characteristics and thoroughly established reliability and practicability. It contains no elements which are objectionable from an operating point of view, and provides all of the flexibility that can be desired for meeting different situations.

As opposed to the direct current system, the single-phase system with commutator motors has the objectionable feature of heavy motors with poor electrical constants and high maintenance costs, while the split phase system using polyphase motors introduces the untried feature of the phase converter, and both these a.c. systems have the objectionable inductive disturbances of the single-phase trolley and transmission. The straight three-phase locomotive is hampered by the double overhead trolley which resists its use to special situations.

The list herewith of lines in the United States will indicate the widespread interest being shown in high voltage operation. This list is taken from a recent paper by Mr. John A. Dewhurst, of the General Electric Company.

The Sherbrooke Railway & Power Company

The gross earnings of the Sherbrooke Railway & Power Company for the three months ending September 30th, 1913, amounted to $39,594, an increase of 18.5 per cent. over the same period in 1912. Operating expenses increased at a slightly higher rate namely 20.1 per cent., but the increase in net is still 16.3 per cent. Earnings will be further enhanced by the power contracts with the Canadian Brakeshoe Company amounting to 700 h.p., the Canadian Connecticut Cotton Mills 500 h.p., and the Panther Rubber Company 150 h.p. It is also expected that smaller contracts will total another 150 h.p. These will in all probability be in operation within the next six months.

Miscellaneous

The Danforth avenue extension of the Toronto municipal railway system was opened for service on October 30th. This line will operate ten new cars.

It is reported that The Hamilton Incline Railway Company will expend $200,000 on the installation of a 1000-foot incline railway, lifting a distance of 319 feet.

Of the five radial railway schemes suggested in connection with the Whitby and Port Perry district the more general scheme has been indorsed by the municipalities. This calls for a 71-mile line.

The new car line along Terauley, Agnes, Anderson and St. Patrick street was opened for service on Saturday, November 1st. It is hoped this new outlet will considerably relieve the down-town congestion.

Arrangements have been made by which the Edmonton Interurban Railway Company are allowed to connect up their line with the Edmonton municipal system. The interurban company are operating a gas electric car at the present time and will have another in service in the near future.

The construction of the railway line to Shaganappi Park which has been suggested by certain parties interested in real estate at that point will not be undertaken by the municipality of Calgary. This decision was arrived at following a lengthy meeting and discussion which resulted in an adverse vote of 28 to 5.

By a decision just handed down by the Privy Council the Toronto and York Radial Railway will not be allowed to deviate their Yonge street track at Farnham avenue. This practically means that when the franchise expires in 1915 the company will have no means of entering their North Toronto station unless they can come to terms with the city in the mean time.

By direction of the Montreal controllers, Mr. G. R. MacLeod, the municipal railways and tramways engineer, compiled a report on suggestions made by various aldermen as to new tramway lines required in the outer wards. This, however, has been referred back for Mr. Janin, the chief engineer, and Mr. MacLeod to make recommendations as to what they consider necessary to meet public requirements.

Interests in connection with the Winnipeg Electric Railway Company have acquired what is known as Big Bonnet Falls on the Winnipeg River. These falls will be developed by a subsidiary company and the street railway company will take the full output of the development. It is the intention, as soon as the engineering staff can be organized, to start development work. From data in the possession of the company this site when fully developed will be capable of turning out from 80,000 to 100,000 horsepower.

New Books

Electric Circuit Theory and Calculations—By W. Perren Maycock, M.I.E.E.; Whittaker & Company, London and New York, publishers; price 3/6. The object of this book is to explain the theoretical principles underlying numerical problems relating to electric-installation circuits, and to show how such problems may be worked out. The magnetic circuit, which concerns design work rather than installation, is omitted. A collection of examination and other questions, at the end, form useful exercises for the reader, and as the work is intended for beginners a part on arithmetic has also been included. A number of well chosen illustrations have increased the practical value of the book.

The Dealer and Contractor

Isolated Plant in New Y.M.C.A., Toronto — The Wiring and Lighting of a Large Public Building

A very complete isolated plant has just been placed in operation in the new Y. M. C. A. building, College Street, Toronto. There are two units, both engine driven, one of 50 kw. and one of 75 kw. direct current, 230 volts, 3-wire, Bruce-Peebles manufacture. The engines are twin cylinder 10 x 10 x 6, 550 r.p.m. Goldie-McCulloch manufacture. The plant is illustrated in Fig. 1.

The current is carried from the generators by cable in conduit, in an underground waterproof trench, to the main switchboard which is a three-panel type with circuit breakers, volt meters, ammeters, etc. The generating equipment and main switchboard were supplied and installed by Mr. R. H. Nichols, Dineen Building, Toronto.

From the main switchboard the current passes by overhead conduit to the distributing board which is located in a separate adjoining room. The main switch and metering board was supplied by the Canadian Krantz Electric Manufacturing Company, Limited. In addition to the usual instruments this board is of polished black slate, mounted on an angle iron frame with grills at each end and on top. This board is back connected with laminated bus-bars and lugs for all switch connections. Knife switches are of polished copper with enclosed fuses and name plates on each switch. The following double or single throw 3-pole switches are mounted on the board:—

Lighting section, 110/220 volts—1-350 ampere, 1-250 ampere, 3-100 ampere, 5-75 ampere, 3-50 ampere, 1-25 ampere.

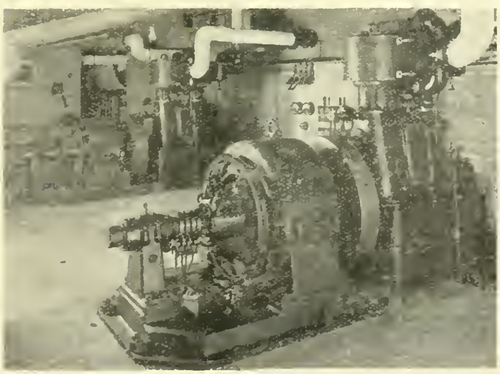


Fig. 1—Steam engine driven generators New Y.M.C.A.

Power switches 240-480 volts—2-100 amp., 3-50 amp., 4-25 amp.

The board distributes current for lighting, ventilating fans, vacuum cleaners, elevators, sump-pump and swimming tank pump. There are five ventilating fans operated by Sprague motors of approximately 5 h.p. capacity each. The vacuum machine is a Spencer turbine cleaner, 4 sweepers, with 37 outlets, operated by a 10 h.p. motor. The swimming tank pump is operated by a 5 h.p. Bruce Peebles motor.

There are 15 panel boards of Krantz manufacture B.3-2 wire, 110/220 volts, installed throughout the building, ranging from 6 to 34 circuits, all circuits being controlled by knife switches. These panels are of the finest polished black slate and all copper is polished and lacquered.

Fig. 2—The main hall has semi-indirect units.

There is nothing unusual in the wiring arrangement. The wires are all carried in conduit to the outlet boxes and there is no exposed work whatever in the building. In all there are 996 ceiling outlets and 29 wall outlets for lighting; in addition there are a few Diamond H wall plugs and 7 lantern floor plugs. These latter are all of a heavy type manufactured by the Russell-Stoll Company, New York. All push type switches are of the Diamond H Variety. A complete telephone equipment is being installed by the Bell Telephone Company. The wiring was installed complete by Bennett & Wright. The conduit was supplied by Conduits Company, Limited.

The types of fixtures used in the various rooms are of special interest. Both direct and semi-indirect units have been utilized. Fig. 2 shows one end of the main entrance hall which is entirely lighted with semi-indirect bowls fourteen inches in diameter suspended by three brass chains approximately two feet from the ceiling. As may be seen from the figure the feed wires are run down the chains so that nothing is visible which will detract from the artistic appearance of the fixtures. Each bowl contains three 40 watt lamps. These bowls, as shown, are suspended from a metal ring frame and provision has been made in these frames so that a cover glass of plain window quality can be laid above the light units as a lid to the fixture. This is done with the idea of keeping dust and dirt out of the bowl-

so that these and the lamps will be clean at all times. The plain glass covering, being flush with the top of the bowl, can be brushed off and kept clean with a minimum of labor. In addition to the rotunda, the offices, social rooms, library

Fig. 3—Fixture used in hall-ways.

and a large auditorium are lighted in the same way by the indirect type of fixture shown in Fig. 2 and the resultant illumination is remarkably even and satisfactory.

The corridors throughout are lighted by direct units set up close to the ceiling as shown in Fig. 3. The supporting base is of bronze finish. In the classrooms this same type of unit is used in fixture groups of two or four, the units being inverted and constituting a semi-indirect system of a very simple and effective character. The fixtures here are also finished in dark bronze and combine low cost with efficiency and pleasing appearance.

The bedrooms are fitted with units similar (only smaller) to that shown in Fig. 3, but these are suspended by a flexible cord and the socket is supplied with a short chain to switch

Fig. 4—One corner of the swimming pool.

the lights off and on. The ceiling canopy used in the bedrooms is of white porcelain which can be easily cleaned and fits in well with the simple decoration of these rooms.

A corner of the swimming pool is shown in Fig. 4. In this case the lamps are enclosed in spherical globes. Though these sacrifice the efficiency of the system somewhat they give an excellent general illumination of the pool and the units do not interfere in any way with the swimmers.

The gymnasium for the most part are fitted with 150 watt tungstens in clusters of three, hung high, with a broad steel reflector, the lamps being enclosed in a wire guard cage. Under the galleries a similar unit is used containing only one lamp.

Each of the five bowling alleys is illuminated by six

Fig. 5—Main entrance, showing solid bronze standards.

Benjamin enamel steel reflector sockets containing 100 watt lamps.

Each billiard table is lighted by three fixtures suspended from the ceiling by brass chains, the reflectors in this case being aluminium, parabolic type, about 14 inches in diameter.

Fig. 5 shows two solid bronze standard lights installed at the main entrance. The lamps are enclosed in 12-inch spherical globes.

The glassware throughout is Moonstone manufactured by the Jefferson Glass Company. The fixtures were designed and manufactured and the complete installation made by McDonald & Willson, Limited.

The Barcelona Traction Company

In connection with the new enterprise of Dr. F. S. Pearson in Barcelona, Spain, known under the name of The Barcelona Traction Company, and in which considerable Canadian money is invested, the well-known Swiss turbine builders, Escher Wyss & Company, have secured large contracts for the supply of water wheels and pipelines. Besides an auxiliary plant of 4,000 horse-power, four large installations are being equipped, three of which utilise water from the river Ebro. The first installation comprises five units of 16000 h.p. each under a head of 140 feet and is nearing completion. For the second and third, the turbines are well under way in the works and are being rushed to completion. These installations comprise in one case four units of 15000 h.p., under a head of 250 feet and in the other, four units of 11500 h.p., under a head of 165 feet. The same company are supplying the water wheels and pipelines for a high pressure plant in the Pyrenees, built by a subsidiary company at the Barcelona Traction Company; in this plant there are five turbines of 7000 h.p., capacity each, under a head of 2800 feet.

Association of Sign Manufacturers

Members of the electrical trade will be interested in the announcement of the organization of the National Association of Electric Sign Manufacturers. The membership includes manufacturers of electric sign and illuminated advertising displays in Class A; and manufacturers of electric sign materials and accessories in Class B. This association has been agitated for a long time and the need of it is plainly set forth in the objects of the association which are as follows:

1. To combat hostile sign legislation, local and at large. To change unfair and restricted city ordinances pertaining to electric signs; and to oppose taxes and licenses on signs.

2. To disseminate a knowledge of the benefits of electrical advertising. This will be accomplished by means of advertisements, photos, and write-ups in the popular magazines, merchants' trade papers in all lines, and through the press associations.

3. To generally promote the welfare of its members.

4. To maintain a bureau in charge of the secretary which shall guard members of the association against employing agents or salesmen who have proved dishonest with other companies.

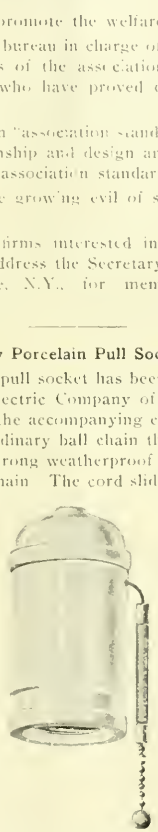
5. To establish an "association standard" for high quality of material, workmanship and design and to impress on the public the merit of "association standard" goods.

6. To combat the growing evil of stealing sketches and matching prices.

Individuals and firms interested in affiliating with the association, should address the Secretary, 315-21 South Warren Street, Syracuse, N.Y., for membership application blanks.

New Porcelain Pull Socket

A new porcelain pull socket has been placed on the market by the Arrow Electric Company of Hartford, Connecticut, as illustrated in the accompanying cut. Instead of being equipped with the ordinary ball chain the socket is operated by a short piece of strong weatherproof cord to which is fastened the insulated chain. The cord slides easily through the

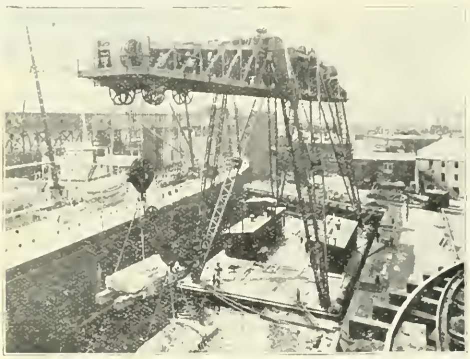


opening in the porcelain shell, making an easy-acting socket, and the cord has been proven by tests to be even more durable than the ball chain on this type of socket. This company is represented in Canada by the Northern Electric & Manufacturing Company.

British imports of electrical goods and apparatus other than machinery and insulated wire for the nine months ending September 30th, 1913, were £1,130,923. This is an increase of £94,547 over the similar period for 1912 and £118,-280 over the same period for 1911.

Accurate Control of Giant Floating Cranes

The accompanying illustration shows one of two new pontoon cranes recently made for the United States Navy Department by the Wellman-Seaver-Morgan Company. One of these 150-ton cranes is for Boston Harbor and one for Pearl Harbor, Honolulu, and are to be used for unloading to lighters where good harbor facilities are lacking and for handling, removing or replacing such machines and apparatus as turrets, boilers, guns, etc., on battleships. Two of the rigid tests made by the Navy Department engineers before



150 Ton Floating Crane in Action.

acceptance and referred to below are an indication of the accuracy of control provided by the magnetic type controllers which were installed by the Cutler-Hammer Manufacturing Company.

In order to test nicety of landing heavy weights, the weight was suspended over an empty oil can, with block on top of it, and then lowered so as to strike block, being stopped upon signal. It is possible to stop the load without injuring the oil can or deforming it. To further test this point, the weight was suspended about two inches over the block and then lowered to see how close it could be brought without touching. It was brought within 1-16 in. of the block.

New Companies

The Shipman Electrical Company, Limited, has been incorporated, with head office Winnipeg, Man.

The National Electric Manufacturing Company, Limited, has been incorporated in the province of Alberta, with head office Calgary, Alta.

The Quebec Development Company, Limited, of Montreal, has been incorporated with a capital of $2,500,000.

The Ottawa Traction Company, Limited, has been incorporated, the capital stock $10,000,000, and head office Ottawa.

The Manitoba Electric Water Heating Company has been incorporated, with head office Winnipeg.

The C. E. A. Carr Company has been registered to carry on business as manufacturers' agents in railway supplies.

Heinze Electric Company, Limited, has been incorporated to manufacture and deal in electrical apparatus and supplies, with head office at Walkerville.

The Electric Manufacturing Company of Canada, Limited, has been granted a charter, head office Montreal, Que.

The Valleyfield Water Power Company, Limited, has been granted a charter by the Dominion government, head office Valleyfield, Que.

The Economy Fuse & Manufacturing Company of Canada, Limited, has been incorporated, head office, Montreal, Que.

Canadian Porcelain Company, Limited

New Factory of Canadian Porcelain Company, Limited

The cut herewith shows the factory of the Canadian Porcelain Company, Limited, of Hamilton. The company was organized under Dominion charter, in November, 1912, for the purpose of manufacturing electrical porcelain and allied products. The plant covers an area of 45,000 square feet and is equipped with the most modern machinery for the production and testing of high voltage line insulators. Electric drive supplied by the Hydro-electric Power Commission of Hamilton is used throughout. Natural gas and bituminous coal will be used as fuel. Raw materials will be secured largely in Canada and England.

Mr. Walter Goddard formerly with the Locke Insulator Manufacturing Company of Victor, N.Y., is president and in direct charge of the company. Mr. F. D. Palmer, of Galt, is vice-president, and Mr. John Alden, of Rochester, secretary-treasurer.

New Type of Warming Pad

A new type of electric warming pad is being placed on the Canadian market by the Hotpoint Electric Heating Company who have recently opened a factory in Toronto. This new device is constructed of aluminium, is about 8 inches in diameter, ⅝ inch thick, concave on one side and convex on the other to fit the body curves. Any temperature between

100 and 200 deg. F. can be secured by simply moving a small lever or the heat can be cut off altogether by a separate switch within easy reach of the user. The heating element in this pad is the same as in the well-known Hotpoint iron and is covered by absolute guarantee. The many advantages this form of pad possesses over the various other styles already in use are claimed by the manufacturers as greater cleanliness, safety, durability and efficiency.

Electric Operation Cheapest

In a recent article on the subject of Drainage and Irrigation, read before the Association of Drainage and Levee Districts of Illinois, it was stated that "all the evidence shows that if a supply of electric energy can be bought for 4 cents per kw.h., that the total cost of pumping by electricity does not exceed the total cost of pumping by steam in well designed steam stations. If a district is able to obtain a lower rate than 4 cents per kw.h. for energy, they are able to save money over the cost of operating steam stations."

The municipal council of Maisonneuve will receive tenders till November 19 for extensions to their pumping system.

Trade Enquiries

1520. **Electric Heaters.**—A South African firm solicits correspondence on electric heaters of Canadian manufacture.

1521. **Electric Irons.**—An Orange Free State firm would like to get in touch with Canadian exporters of electric irons.

1725. **Electrical generators, motors, etc.**—A Yorkshire company manufacturing electrical generators, motors, etc., wishes to get into touch with some first-class Canadian resident firm who possess the requisite connection for introducing and selling their appliances.

Trade Publications

Soot - Cleaner—A booklet issued by G. L. Simonds and Company, Chicago, describing the Vulcan soot cleaner.

Flow Meters.—Bulletin A4157, issued by the Canadian General Electric Company, describing their steam, water and air flow meters.

Transformer Drying—Bulletin number A4134 issued by the Canadian General Electric Company on transformer drying and the drying, filtering and testing of transformer oil.

Metal Moulding—A catalogue issued by the National Metal Moulding Company of Pittsburgh, Pa., and distributed by their Canadian agents the Canadian General Electric Company.

Bus Bar Supports—The Delta-Star Electric Company, Chicago, have issued an exceptionally complete bulletin devoted to high tension bus bar and wiring supports. With the standard units listed over 7,000 combinations are possible thus greatly simplifying high tension stations and switchboard wiring.

Crouse-Hinds.—A folder has been issued by the Crouse-Hinds Company of Canada drawing attention to Canada's bumper wheat crop which will result in renewed prosperity and increased demands for high quality products such as condulets, fittings, panel boards, switches, etc., etc., manufactured by this company.

Railway Supplies.—A bulletin issued by the Electric Service Supplies Company, descriptive of car equipment. Their list is very complete and the booklet particularly well illustrated. The same company are distributing a folder entitled "What Keystone steel gear cases will give you," and a second folder entitled "For Winter," describing auxiliary railway equipment of special need in winter-time.

Westinghouse Publications—The following pamphlets have been issued by the Industrial & Power Department of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.:—Motor-driven Refrigerating and Ice-making Machinery; Number 17 on Small Motors, describing vehicle equipment; Motor-driven Dairy, Creamery and Ice Cream equipment; Westinghouse Watthour A.C. Meters; the Electric Breakfast Set; and Number 5 of the Textile Quarterly, which deals with electrically-driven pickers

Current News and Notes

Atikokan, Ont.

The Canadian Northern Railway Company are installing a stream electric plant at this point for lighting purposes.

Aurora, Ont.

The Town of Aurora, Ont., is installing an equipment of motor-driven turbine pumps for protection against fire. It will include two four-stage high lift turbine pumps of Mather and Platt design, built by Canadian Allis-Chalmers, Limited. Each of these fire pumps will be capable of delivering four hundred imperial gallons per minute, against a total head of 325 feet, operating at 1465 r.p.m. They will be direct connected at one end to an alternating current motor, and at the other end to a direct current motor in order to conform with the Underwriters' requirements that there must be two distinct sources of power for this purpose. The electrical apparatus including a four panel switchboard will be built by the Canadian General Electric Company, Limited.

Ayr, Ont.

A by-law will probably be submitted on January 1 authorizing the council to close a contract with the Hydro-electric Power Commission of Ontario. The plant is at present municipally owned.

Brockville, Ont.

On October 21 the council passed a by-law to spend $69,000 on light and power extensions.

Brantford, Ont.

On January 1 the city of Brantford will elect two members who with the mayor will constitute the Hydro-electric Commission, and will have charge of all electrical matters.

Burford, Ont.

It is expected a by-law will be submitted on January 1st to authorize the council to make a contract for the supply of power from Niagara Falls.

Calgary, Alta.

Tenders are called to November 18th, by the city of Calgary, for a 1000 kw. synchronous motor-generator and exciter set.

Elmira, Ont.

Niagara power was turned on at Elmira on October 29. This village with a population of only 200 has contracted for 250 h.p., probably establishing a new record.

Elora, Ont.

The by-law to raise $10,000 for an electric distribution system carried by a majority of 200 to 8. Elora will contract for 200 h.p.

Estevan, Sask.

The town of Estevan is making an addition of two Babcock and Wilcox boilers fitted with Dutch oven furnaces for burning low class lignite mined in that district; also one compound quick revolution forced lubrication Goldie & McCulloch engine driving a Westinghouse alternator and exciter. The street lights are being improved by putting in sixty 5-light standards and adding light and power main to the capacity of about 20 wire miles.

Forest, Ont.

Further contracts for the new power plant including meters and transformers have been awarded to the Canadian Westinghouse Company. Mr. H. A. McLean, Sarnia, is engineer in charge.

Fergus, Ont.

The by-law was carried on November 3 to expend $16,000 on an electric distribution system. The vote was 174 for to 11 against.

Fort Frances, Ont.

The town of Fort Frances is issuing debentures to the amount of $10,000 to cover the cost of the electric distribution system, which is already built. No immediate extensions are anticipated.

Fort William, Ont.

The earnings of the Kaministiquia Power Company for the ten months ending August 31, 1913, amounted to $208,580, as compared with $216,740 for the previous twelve months. This indicates that the current year's earnings will be largely in excess of the previous year.

The city council will require a quantity of 500,000 c.m. armoured cable to carry the power supply to their new line on Island No. 2.

Professor Herdt, of McGill University, has been appointed one of the arbitrators to determine the comparative cost of electrical energy as supplied to the town of Fort William by the Kaministiquia Power Company.

Guelph, Ont.

At a special meeting of the Guelph city council on October 22nd a resolution was passed recommending that the Hydro-electric Power Commission be asked to make a report on the cost of constructing and operating an electric railway connecting Hespeler, Puslinch Lake, Guelph, Elora, Fergus, Arthur, Mount Forest, Meaford and Thornbury. Owen Sound has also expressed a desire to have the line run to that point.

Hamilton, Ont.

Plans have been completed by the Dominion Power and Transmission Company for the erection of car sheds to be placed on the old site occupied by the sheds that were recently burned.

The cost of street lighting for the year 1914 is estimated at $64,800. This would care for 360 arc lamps and approximately 8,000 tungstens.

The Dominion Power & Transmission Company are contemplating the erection of a steam plant in Hamilton, consisting immediately of 2 units of 10,000 h.p. each with provision for a further addition of 2 similar units. While tentative plans have been prepared it has not yet been decided when the work will be undertaken.

The Hydro-electric System will in the future be administered by a commission of three, consisting of two selected members who will hold office for two years and the mayor who is an ex-officio member. Each will be paid a salary of $1,000.

Herbert, Sask.

The Herbert Electric Light Company, controlled by Mr. H. M. Klassen, is now operating in the town of Herbert. The equipment consists of a 50 brake h.p. Ruston Proctor

producer gas engine and a 30 kw. Westinghouse generator, 2 kw. exciter and switchboard.

Hanley, Sask.

A contract has been awarded to the British Canadian Engineer & Supply Company for a producer gas electric plant. Work on the installation will commence shortly.

Kamloops, B.C.

The new steam plant was started up on October 29th. This plant will be operated as an auxiliary to the hydro-electric plant now under construction when the latter is completed.

Kingsville, Ont.

The Edison Electric Light Company have commenced work on the construction of a transforming station at Kingsville, Ont.

Lacombe, Alta.

Mr. J. C. Gibson of the Lacombe and Blindman Valley Electric Railway Company recently stated that 8 miles of grading is completed and contracts for ties and rails are being let. It is expected the rolling stock will consist of gasoline electric cars

London, Ont.

The London Street Railway Company will require the necessary equipment to transform 1000 h.p. of electric energy, alternating current, as supplied by the city sub-station to 550 volts a.c. as used by the railways.

Before the city of London can proceed with the electrification of the London and Port Stanley Railway line it will be necessary to obtain the consent of the Dominion Railway Board. This threatens to complicate matters somewhat as it will be necessary to convince this board that the proposition is commercially sound.

The Toasted Corn Flakes Company, 584 Grey street, London, Ont., are in the market for 25 cycle, 3 phase motors of a total capacity of 300 h.p.

Medicine Hat, Alta.

The new steam turbine unit of 750 kw. capacity was placed in operation early in November. The boilers are gas-heated. This brings the capacity of the Medicine Hat plant in the neighborhood of 2,000 h.p.

On November 24 a by-law will be submitted regarding expenditure of $150,000 on electric power plant extensions.

Mirror Lake, B.C.

A somewhat unique plant was placed in operation at Mirror Lake, B.C., on October 29th. A number of local ranchers recently formed a company to develop a small water power and purchased a second-hand 36-inch Pelton water wheel and an Edison 35 kw. 110 volt generator which had formerly been used by the Nelson Power & Light plant. The majority of the construction work including the building of some 100 feet of pipe line was undertaken by the ranchers themselves. The company which has been formed is known as the Mirror Lake Electric Light Company.

Montcalmville, Que.

The city council is considering the installation of an ornamental street lighting system.

Montreal, Que.

The Montreal Council have prepared a by-law in connection with the underground conduits on St. Catharine Street and Bluery Street and Park Avenue. This provides that all buildings to be constructed or in course of construction in which electricity will be used for light or power shall be so wired that electrical service connections can be made to the underground distributing system; all existing buildings must have their service connections arranged by May 1, 1914. All work is to be done in accordance with the rules and regulations of the National Board of Fire Underwriters. A penalty not exceeding $40 or two months' imprisonment may be imposed in default of carrying out the by-law.

The earnings for the first four months of the company's year of the Montreal Light, Heat and Power Company amounted to $968,624 as compared with $883,002 for the same period a year ago.

We understand the Southern Canada Power Company are preparing plans to go ahead with hydro-electric development which was recently planned by the South Shore Power and Paper Company. The water power is situated on the St Francis River near Drummondville.

During the last financial year the gross receipts of the West Kootenay Power & Light Company were $415,413, an increase of $82,549, while the operating costs were $115,279, or $5,022 higher, leaving the net $300,134, a gain of $77,527. Four per cent. was paid on the common stock. The company anticipate a further increase in net earnings from the electrification of that section of the Canadian Pacific Railway between Rossland and Castlegar Junction, contracts having been let for the electrical apparatus required for the work. The section should be in operation by the autumn of next year. The following are the officers and directors for the ensuing year:—C. R. Hosmer, president; L. A. Campbell, vice-president; W. R. Baker, Edwin Hanson, Frank Paul, Geo. F. Benson and W. J. Shaughnessy

The Westbury Electric Light & Power Company has been incorporated with a capital of $75,000. The directors are H. A. Worby, manager, Robert C. Cowling, secretary-treasurer, and the place of business, Cookshire, St. Francis, P.Q.

Nelson, B.C.

The shareholders of the Nelson Street Railway Company will sell out to the city at the rate of 50 cents on the dollar, payable in 25-year 5 per cent. debentures. Certain repairs and extensions will be made to the line.

Outlook, Sask.

A by-law was recently passed to expend $10,500 for electric light extensions.

Owen Sound, Ont.

The town council has granted the Mayor the necessary authority to sign a contract with the Hydro-electric Power Commission of Ontario for the supply of 1200 h.p. of electric energy. The price is calculated not to exceed $31 per h.p. delivered at the town limits. A transmission line about 30 miles long will be required to transmit the current from Eugenia Falls where a water power will be developed.

Peachland, B.C.

On November 5 this municipality voted $1,000 for extensions to the electric light system.

Port Arthur, Ont.

The new belt line built by the Port Arthur municipality during the past summer was placed in operation on November 1.

Port Nelson, Ont.

It is expected that the Marconi Wireless station at Port Nelson, Hudson Bay, will be in operation in the early spring. Work will be carried on during the winter, the Government carrying out the construction of the station under the supervision of the Marconi Company

Prescott, Ont.

Power was received for the first time on October 24th over the new transmission line which has been constructed by the Hydro-electric Power Commission between Prescott

and Morrisburg. In the near future the line will be completed to Winchester, Chesterville and other towns in the neighborhood. Power is being supplied temporarily from Morrisburg.

Port Colborne, Ont.

Tenders are called to November 20 for electric wiring and interior fittings of a public building here.

Quebec, Que.

Sitting at Quebec city, the Public Utilities Commission approved the grounding of transformers made by the Quebec Railway, Light, Heat and Power Company. The commission ordered the Dorchester Electric Company to allow its groundings to be inspected by Mr. James Bennett, of Montreal, who was nominated as the commission's engineer, his fee to be paid by the company. The Beauce Telephone Company renewed a complaint to the effect that an electrical system owned by Mr. Lessard at St. George, Beauce, was dangerous, and Mr. Lessard was again ordered to remedy the defects, under the supervision of Mr. Frigon, the inspector appointed by the commission, and to pay the costs.

Regina, Alta.

The street railway returns for the week ending October 18th are as follows—revenue $3,982; passengers carried 97,242; passengers carried including transfers 110,657. Corresponding figures for the week ending October 25 were $3,930, 94,963 and 108,834, and for week ending October 1, $3,998, 98,034 and 112,110.

Russell, Man.

A new gas-electric plant has just been placed in operation. The equipment consists of a Ruston-Proctor 72 h.p. engine and suction gas plant with 50 kw. Westinghouse generator, 2 kw. exciter, switchboard and all the accessories. This plant was installed complete by the British Canadian Engineering & Supply Company of Winnipeg.

Souris, Man.

A contract has been awarded for the installation of a small electric light plant to the Accumulator Lighting Company, Winnipeg, Man.

Smiths Falls, Ont.

Mayor Foster with a number of interested citizens recently visited Long Rapids on the Madawaska River, situated some eight miles out from Arnprior, where it is believed a hydro-electric plant could be installed at a reasonable cost.

A new 275 kw. Westinghouse generator was recently placed in commission. This now brings the generating capacity of the plant to over 1,000 h.p. and the machines are so arranged that they may be driven either by water or steam power. Mr. Ross O'Hara is superintendent of the plant and Mr. George Frost manager.

St. Catharines, Ont.

By a vote of 715 to 48 the by-law to expend $116,000 on a step-down transforming station and distributing system was carried by the property owners of St. Catharines. The by-law to grant a three years' renewal of the street lighting contract to the Dominion Power & Transmission Company was defeated.

St. John, N.B.

A generating plant with a capacity of 500 h.p. is being installed in the new elevator here; also a small lighting machine of 50 h.p. The equipment throughout the elevator will be motor driven. The W. J. O'Leary Company are in charge of the electrical construction work.

Saskatoon, Sask.

The rate charged by the city for power supplied to the street railway system will be reduced on January 1st to 2 cents per kw.hr.

It is understood arrangements have been made to extend the electric light and power line out to Factoria, a sub-division about three miles north of the city limits of Saskatoon.

The suburban electric line has been completed connecting Sutherland with Saskatoon, a distance of between two and three miles, and street cars have already been operated over the road.

St. Thomas, Ont.

The matter of erecting a large electric sign to advertise the city is being discussed by the council.

Estimates have been prepared on the cost of extending the city street railway system from the end of the Ross street line to Pinafore Park. The cost would be in the neighborhood of $30,000.

Thorold, Ont.

A by-law will be submitted on January 1 authorizing the construction of a street railway to accommodate the factories at the south end of the town.

Toronto, Ont.

The Canadian Stewart Company, who have contracted to do the work of dredging the Toronto harbour, have made a request for rates on 8,000 h.p. of electric energy.

A contract has been closed by the Toronto Hydro-electric Power Commission with the T. Eaton Company, Limited, for the supply of 2,500 h.p. to the latter company on a flat rate of $20.

Wolsely

Work is progressing on a 22 x 17 ft. addition to the municipal light and power plant in which an additional 30 kw. generator with exciter and switchboard is being installed.

Winnipeg, Man.

The Public Utilities Commission will inquire into and report upon the possibilities of a hydro-electric scheme for the benefit of the farmers of the province. Commissioner Robson has already invited representatives from people interested in the question and will attend at different points to investigate the various local propositions that may be suggested.

Tenders will be received by the Board of Control up to December 1st for next year's supply of meters.

Tenders have been received by the Canadian Credit Men's Association, Limited, at a rate on the dollar, for the stock, fixtures and machinery of the electrical business belonging to the United Electric Company.

Contract has been awarded the Imperial Wire & Cable Company for 5,500 feet of 2,200 volt, three core, paper insulated, lead covered cable.

Tenders have been received by the Board of Control for the supply and installation of five complete pumping units together with stepdown transformers, switchboard and accessories.

Mr. W. G. Chace, formerly chief engineer in charge of design and construction of the city's power plant, has been appointed chief engineer in charge of the new water supply system. It is anticipated that this work will take five years to complete, at an estimated cost of approximately $13,500,000. The object is to bring into Winnipeg from Shoal Lake, a distance of 92 miles, a supply of soft water by gravitation.

Messrs. Willoughby & Kelso have been awarded the contract by the city of Winnipeg for the erection of ornamental lighting standards on Main, Osborne and Hargrave Streets.

Yorkton, Sask.

Tenders are called to December 22nd for the supply and delivery of one 500 B.h.p. gas-electric unit.

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

Second Hand Electrical Machinery

Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

GREGORY ELECTRIC CO. CHICAGO, ILLINOIS

Established 1893

Positions Wanted

An Engineer (28) A.M.I.Mech.E., A.M.I.E.E., desirous of making a change, is open to receive offers from those requiring a first class man to fill a responsible position. Advertiser at present holds post of Mechanical Engineer and Electrical Superintendent to one of the largest Mining and Industrial concerns in Canada, has seen considerable service abroad and would go anywhere at all. Is tactful and energetic with strong initiative and organizing capacity and has highest credentials. Salary according to locality. Apply Box No. 896, Electrical News, Toronto. 20-22

Electrician, experienced in power plant operation, maintenance and repairs, desires situation. First class references. Apply Box 901, Electrical News, Toronto. 21-22

ENTERPRISE ELECTRIC CO.

CALGARY, CAN.

Owing to the duty and heavy freight charges, desires to buy electrical and gas goods of every description under price. Job lots from Wholesalers, not entirely out of date, would be considered. Write us, giving description and particulars. 22

FOR SALE

Canadian Rights for an Electric Device which has been an immense success in the United States. Address Box 887, Electrical News, Toronto. 20tf.

Sales Agent Wanted

Large firm manufacturing carbon brushes wants good Canadian distributor who can carry stock in Canada. Apply Box 898, Electrical News, Toronto. 21-22

FOR SALE

One 60 cycle, 25 horsepower, 1333 r.p.m., 220 volt, Form U S Induction Motor, C.G.E. manufacture, in good repair. Equipment includes one 4-pole single throw knife switch with Noark enclosed fuses, pulley, gliding base and starting compensator containing oil-switch in base.

Standard Wire Fence Company,
F Woodstock, Ont.

TOWN OF YORKTON

SASKATCHEWAN

Tenders for Diesel Electric Machinery

Sealed tenders, marked "Tenders for Diesel Electric Machinery," addressed to T. F. Acheson, Secretary-Treasurer Town of Yorkton, Sask., will be received up to 12 o'clock, **Monday, December 22nd, 1913**, for the supply and delivery of one 500 B.h.p. combined unit. Specifications and all information may be obtained upon application to M. M. Inglis, Electrical Engineer, Yorkton.

The lowest tender not necessarily accepted and the right is reserved to reject any or all tenders.

T. F. ACHESON,
22-23 Secretary-Treasurer.

Electrical News
Generation, Transmission and Application of Electricity

Published Semi-Monthly By

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Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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The "Electrical News" will be mailed to subscribers in Canada and Great Britain, post free, for $2.00 per annum. United States and foreign, $2.50. Remit by currency, registered letter, or postal order payable to Hugh C. MacLean, Limited.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 22 Toronto, December 1, 1913 No. 23

Central Station Co-operation

Much has been written about the central station manager being under an obligation to push, actively, the sale of electric vehicles, and it has come to be taken for granted that he reaps a very large harvest from electric vehicle customers, and therefore is justified in making almost unlimited expenditures in effecting sales. There is decidedly another side to the question, however, and this has been taken up very capably by Mr. E. L. Callahan representing the central stations in a paper printed elsewhere in this issue. The point is brought out, and it is a good one, that the so-called harvest of the central station consists in selling the electric vehicle owner current, at an exceedingly low rate, to an amount which represents less than 10 per cent. of the total cost of operation of the vehicle, and the question is naturally raised why other lines of trade reaping larger benefits should not be counted equally responsible in pushing the sale of electrics. It is pointed out too that profits are often much larger from the "insignificant" little things such as flat irons. It is timely that some one has come to the defence of the central station. The manufacturer, and the public too, may have been expecting too much of the seller of electric current and it is very possible that many a prospective customer may have held aloof at what he considered a lack of confidence on the part of the central station owner in electric vehicles. Looked at from this other side, it would, however, be about as reasonable to expect the manufacturer of rubber tires, or electric lamps or of some other accessory to be actively engaged in selling electric vehicles. If the public can only be brought to see that the central station has comparatively little to gain they will naturally cease to mistrust. The co-operation of the central station is, of course, always a factor to be reckoned with, but the manufacturer himself seems the logical salesman.

We are inclined to think the greatest assistance the central station could give the manufacturer would be his "moral" support in the purchase of one of the vehicles for his own use. It would be of real assistance if the manufacturer could point in every case to the central station as one of his customers. On his part, the central station owner is often in a better position to use an electric than any other man in his city, first, because he has in his employ men who understand the care and use of electrical equipment and, second, because the charging can be so arranged that it costs him little or nothing. Co-operation to this extent may naturally be looked for by manufacturers, not only of electric vehicles but of other electrical equipments and appliances. However if the electric iron yields a larger profit than the electric vehicle the central station owner is only human in being more interested in the electric iron.

The Society for Electrical Development

It will be of interest to manufacturers, as well as to the other branches of the electrical business, to know that forty-one manufacturers have taken out membership in the Society, aggregating over $80,000 annually as their subscription to this very important trade movement. The particular group of forty one referred to are members of the Electrical Manufacturers Club, at whose meeting last week in Hot Springs the Society was a live topic of discussion both in the meeting and the lobbies.

The affiliation with the society of the other members of the Club is being carefully considered, and their co-operation will undoubtedly raise the subscriptions from this particular group to over $100,000 annually.

The President of the Club, Mr. S. O. Richardson, Jr., in introducing the subject, gave the movement his warm personal endorsement, backed by the statement that his interests, the Libbey Glass Company, joined some months ago. Mr. J. Robert Crouse, in a brief address, emphasized the basic principles involved with special reference to the manufacturers. Mr. Gerard Swope, vice-president of the Western Electric Company, followed, explaining the detail plan of organization and the balanced representation of the grand division of the business. He expressed the opinion that the plan and personnel of the officers and directors gave every promise of efficient and economical expenditure in the work.

Mr. F. S. Terry, manager of the National Lamp Works, addressed the meeting with reference to results which the society can accomplish. He explained that the result of the earlier efforts in this same work in 1906 and 1907 had greatly exceeded expectations, and indicated an efficiency in market development by these methods which can not be attained in any other way.

During the meeting, President Richardson received over fifty telegrams from electrical supply jobbers in all parts of the country, stating they were members, expressing their conviction of its value and the hope that all the manufacturers would join in the movement.

There are, of course, many manufacturers not members of the Electrical Manufacturers Club, so that the figures given in the beginning of this paper are less than the actual facts. The society's objects, plans and methods of membership need only to be really understood to make a successful appeal to those who have not yet joined as it has done to the 700 and more companies in membership. It is in effect a wonderful opportunity for the electrical business to blaze a new trail in creative market development that will be in keeping with the great achievements in electrical research, engineering and manufacture.

A pamphlet covering concisely the principles, plans and

method of membership will be gladly sent, on request to the Society for Electrical Development, Engineering Societies Building, New York.

Hydro Plant for Charlton

The Charlton-Englehart Light, Heat and Power Company are constructing a hydro-electric plant at Long Lake on the White or Blanche River. The natural conditions at this point are such that the power can be developed at a very reasonable cost. Long Lake itself constitutes a splendid storage basin and the rapids to be utilized are situated right at the head of the White River where it leaves Long Lake. For this reason only a very low dam will be required, with a minimum excavation as the river is shallow and down to solid rock. This also is the site of the town of Charlton through which a railway line passes, and the equipment will therefore be delivered practically on the site of the development, thus removing one of the large sources of expense in the average northern plant where the power site is often practically inaccessible.

The hydraulic equipment is being supplied by the William Hamilton Company, Limited, of Peterborough. There will be two vertical turbine units each consisting of a 35-inch Samson water wheel enclosed in a steel plate case with butterfly valves six feet in diameter, and Lombard governors for each unit. Each water wheel unit will have a capacity of 540 h.p. a working head of 37 feet, running 300 r.p.m. The same company have supplied a ten-ton, hand-operated traveling crane as well as the foundation beams for the water wheels, the trash racks and supports.

The head race, which is constructed of concrete, is approximately 125 feet long. Below this there will be 233 feet of 7-foot diameter steel pipe dividing into two branches each 40 feet long and 6 feet in diameter. The pipe line is also being supplied and erected in place by the William Hamilton Company.

The power house, which also includes the transformer house, is 28 ft. x 80 ft., and will be of concrete and steel construction. As regards the transmission line, there is already built and in operation from Charlton to Englehart a transmission line some seven miles long which will carry a current at 11,000 volts. There is also constructed in Englehart a sub-station for the transformation of this current for local use. At the present time there is a small water wheel generator equipment operating in a sawmill on the same falls which is supplying light to Charlton and Englehart. Negotiations are being carried on with consumers in the Swastika district, and if it is decided to supply power to this point, it is understood transmission will be at 33,000 volts.

The electrical equipment is being supplied by the Burnham Engineering Company who will also superintend its installation. This equipment will consist of two 400 kv.a., 60-cycle, 3-phase, 2300 volts, 300 r.p.m. vertical water wheel generators and two vertical belt driven exciters. The Burnham Engineering Company will also supply the generator, switchboard and the switching equipment at the power plant and in the two sub-stations.

Sutcliffe & Neelands are consulting engineers in connection with the installation. Mr. K. Farah is superintendent of the Charlton-Englehart Light, Heat & Power Company.

Souris Lighting Plant

The town of Souris, Manitoba, has awarded a contract to the Accumulator Lighting Company of Winnipeg for the supply and installation of a complete lighting plant to be owned and operated by the municipality.

It is the intention to supply only direct current and for this purpose there is being installed a battery consisting of 120 cells of approximately 1200 ampere hours capacity. These cells have a voltage of 2.70 and are contained in lead lined boxes and arranged to conform to a three-wire 220-110 volt distribution system. The charging end of the equipment consists of two generators one of which will be a spare. The capacities of these generators are 50 kw. and 30 kw. respectively. They are to be belt connected and driven by either of two gas-producer engines of 86 h.p. each, which are at present in use in connection with the water system. The general system of distribution will be, as stated above, a three-wire 220-110 volt system, while the automatic control of street lighting will be taken care of by stringing a fourth wire and connecting it through a time switch to one of the outside wires at the station. The 110 volt street lamps will be connected in parallel across this fourth wire and the neutral of the distribution system thus obtaining independent control of the street lighting at very slight additional cost.

The anticipated average demand on this plant is about 200 amperes consisting almost entirely of lighting. Street lighting will be done by 60 watt tungsten lamps on ornamental iron standards supplied by the Brandon Foundry Company and in addition there will be 130 goose necks, with a single 100 watt tungsten lamp each, for attachment to wooden poles in the outlying sections of the town. Of the ornamental standards there will be 38 two lamp, 7 four lamp, and 17 five lamp units, the latter consisting of four 60 watt lamps surmounted by one 100 watt lamp.

The contract on this plant includes the supply of a balancing set consisting of two 110 volt generators, two charging generators as mentioned above, the storage battery, the necessary switching equipment and board, and erection.

Smithers Light and Power Plant

Arrangements have been completed by Messrs. J. A. Fraser and L. A. Harrison, of Skagway, Alaska, to establish an electric light and power plant in the town of Smithers, a new divisional point on the main line of the Grand Trunk Pacific Railway in Northern British Columbia. The project provides for the immediate installation of a steam plant which will take care of the lighting and power requirements in the district during the coming winter, the equipment consisting of a steam engine to drive a 2300 volt, 2-phase generator carrying 4,000 lamps at a peak load and supplying at least 150 kilowatts for power purposes during the day time. On account of the lateness of the season, it was not considered practicable to proceed with the installation of a water power station this year, although plans have been perfected for a development of this nature on the Bulkley River, a short distance from the town.

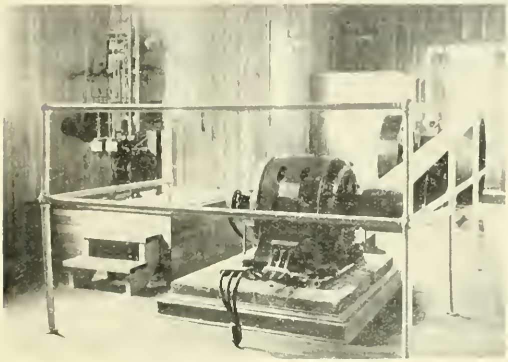
A tentative list of the charges to be made for power and light in Smithers provided for a minimum, including meter rent, of $2 per month, with a discount of 15 per cent. if paid on or before the 15th of each month. The following sliding scale of monthly charges is expected to be put into effect: Up to 49 kw.h., 18 cents; 50 to 124 kw.h., 17½ cents; 125 to 249 kw.h., 17 cents; 250 to 499 kw.h., 16½ cents; 450 to 749 kw.h., 16 cents; 750 to 999 kw.h., 15½ cents; above 1,000 kw.h., 15 cents.

The price of current supplied for electric motors of five horse-power and over will be at a flat rate of $5 per rated horse-power per month.

All other current supplied for power purposes is at the rate of 10 cents per kilowatt hour. The voltage for lighting circuits will be 110 volts, alternating current, single phase. The voltage for power up to, but not over five horse-power, will be the same as for the lighting service. For motors over 5 horse-power, the voltage will be 220 volts, alternating current, 2-phase. It is the intention to reduce these rates when the power plant is completed.

A Pioneer Electric Plant

The lighting plant operated by the Northern Telephone & Power Company in South Fort George, B.C., provides the first distribution system in that district and is a pioneer plant in every sense of the term. Erected under peculiarly adverse conditions in a practically undeveloped section of the province, this plant is a noteworthy example of the enterprising spirit which enters so largely into the daily lives of those associated with the upbuilding of new communities in British Columbia. The equipment consists of one 62½ kv.a., three-



Plant carried 310 miles by horse pack trains.

phase, 2300 volt, 60 cycle generator, belted to a 12-in. x 12-in. centre crank Ideal engine supplied by Messrs. Robert Hamilton & Company, Vancouver agents for Messrs. Goldie & McCulloch, of Galt, Ont. There are two 40 h.p. portable fire box boilers, burning wood fuel which can be obtained in practically inexhaustible quantities in the surrounding district.

All of the electrical apparatus was supplied by the Canadian General Electric Company, and was first shipped from Vancouver to Ashcroft, the nearest point on the main line of the C. P. R. to South Fort George. At Ashcroft the equipment was transferred to horse pack trains and conveyed in this primitive fashion for a distance of 310 miles over rough mountain trails through a country of the wildest description, to its destination.

Their Second Anniversary

On October 13th last the Light and Power Department of the City of Winnipeg celebrated the second anniversary of their birthday and in this connection it is interesting to note the following figures given out by sales manager R. A. Sara which strikingly illustrate their success during these two years of operation. On October 15th, 1911, they connected up their first customer. On October 15th, 1912, they were serving 14,598 customers which figure had increased to 25,615 by October 15th, 1913. Up to October 15th, 1912, the gross output was 19,802,700 kilowatt hours and the gross billings were $243,706.56. During their second year of operation between October 15th, 1912, and October 15th, 1913, the gross output amounted to 43,624,500 kilowatt hours and the gross billings had increased to $767,648.87, that is an increase of over 100 per cent. per year in output and over 200 per cent. per year in gross billings. The gross billings for the month of September, 1913, were $69,619.83 and it is fully expected that they will amount to well over $75,000 per month during the winter months. The peak load for October, 1913, was 12,950 kilowatts and during the month of October, 1912, it was 8,800 kilowatts.

City of Calgary Power Plant Equipment

The following summary of the power situation in Calgary is indicative of steady and sound development and certainly does not show any sign of the general "depression" about which we hear so much. There is probably no more important element in the maintenance of steady business growth than an abundant supply of electric power at reasonable rates. This is evident at the present time not only in Calgary, but in the rapid return to normal conditions being shown by many other of our towns and cities.

Purchased

3800 kw. is purchased from the Calgary Power Company at a rate of $26 per h.p. per annum on a half hour monthly peak basis.

The steam equipment of the City of Calgary's plant is as follows:—

A.c. equipment—in operation.

1—2800 kv.a. turbo-generator, Allis-Chalmers.
1—3125 kv.a. turbo-generator, Belliss-Vickers.

Now being erected.

1—6250 kv.a. turbo-generator, Allis-Chalmers.

D.c. equipment—for street railway operation.

1—600 kw. steam driven generator.
1—500 kw. steam driven generator.
2—1000 kw. motor generators.
1—500 kw. motor generator.
1—300 kw. motor generator.

Boilers—in operation.

12 Babcock & Wilcox 3580 sq. ft. heating surface.
4 Babcock & Wilcox 2823 sq. ft. heating surface.

Now being erected.

4 Babcock & Wilcox 6000 sq. ft. heating surface.

Street lighting equipment.

4—75-light Westinghouse mercury arc rectifier sets.
8—75-light C. G. E. mercury arc rectifier sets.
2—100-light a.c. constant current arc light equipments.
6—35-light a.c. constant current arc light equipments.
700 magnetite arcs.
300 enclosed carbon arcs.
300 250-watt tungstens.
100 600-watt tungstens.

Power,—demands at the present time are as follows:

Street lighting load, 1000 kw.
Commercial motor load, 2000 kw.
Street railway load, 2600 kw.
Lighting load, 3700 kw.
Normal day load, 5300 kw.
Combined evening peak, 7000 kw.

Edmonton Activities

As indicating the growth of Edmonton and the corresponding growth in the demand for electric power the following comparative figures of the output of the municipal plant for the months of September and October are interesting:—

	September	October
	kw.h.	kw.h.
Power to electric light dept. ..	993,400	1,177,300
Power to street railway	604,400	647,657
	(Imp. gals.)	
Water to Water Works Dept...	136,849,000	143,142,815

The electric railway operations are gradually improving in Edmonton. During October of the present year the expenditure was $64,800 against a revenue of $52,000 as compared with a year ago when the expenditure was $60,000, against a $43,000 revenue. During the year the city has laid 23 miles of permanent track. Also the rate for current has been reduced from 2.4c to 2c, and it is hoped that in the very near future the system will begin to show a profit.

The city council has reduced the cost of power to all off-

peak power customers to a flat rate of 2c per kw.h. This is taken to include the street railway and the water-works departments. The rate for lighting to the city will be 3c. The following is a summary of the new schedule which was drawn up by Messrs. Ormsby, Woodroofe & Parsons, respectively the superintendents of the electric light, the electric railway, and the power house departments:—

(1) Rates to electric light department: 3c per kw.h. on all lighting feeders; 2c per kw.h. on all off-peak power feeders, it being understood that these feeders are used for power only, and that although in general a 24-hour service will be maintained on them, they are liable to be switched off when necessary at the time of peak load on the power house.

(2) Rates to street railway 2c per kw.h., current to be metered as at present.

A large new territory in the suburban districts has been covered with lights and was illuminated for the first time during the second week in November.

The telephone department has received a shipment of automatic telephone equipment sufficient to install 1,000 new instruments.

Electrification of Railways

Mr. G. Percy Cole, M.Sc., Mem.A.I.E.E., Assoc.M.I.E.E., of the Canadian General Electric Company, addressed the members of the Canadian Railway Club on "The Conservation of Natural Resources through the Electrification of Railways." He spoke of the enormous cost of running locomotives by coal, and estimated that the annual consumption of coal by locomotives in Canada and the United States is approximately 110,000,000 tons. If it were possible, he said, to save two thirds of this, valued at $2 per ton, a yearly saving of roughly $147,000,000 would be effected, which would go a long way towards paying for electrification of our railways. In the process of turning the coal into power we are throwing away 90 per cent. of its value—a serious national concern. When it is considered that 70 per cent. of the average railroads revenue from operation is obtained from the transportation of freight, it is easy to see why railway managers are beginning to study the question of electrification from the standpoint of economy.

Dr. L. A. Herdt and Professor McKay, McGill University; L. C. Ord, of the Canadian Pacific Railway; W. H. Winterrod, electrical engineer, C. P. R.; and R. H. Wheeler, electrical engineer of the Canadian Northern, took part in the discussion which followed the address.

A 10,000 h.p. Motor Installation

Among the many new mills in course of construction along the route of the new Welland Ship Canal, the largest and at the same time most interesting from an electrical point of view, is that of the Ontario Paper Company, at Thorold, known locally as the million-dollar paper mill.

The mill is situated about a mile and a-half from the town of Thorold and is supplied with electrical power by the Ontario Power Company, Niagara, Ont. Power is transmitted to the mill at a pressure of 12,000 volts over two 3-phase aluminium transmission lines together with two auxiliary copper lines. These lines enter the mnll through a switch house containing line disconnecting switches, electrolytic lightning arresters, etc., and also two 150 kw. transformers for fire-pump service.

The current is taken from the switch house to the motor room in three core cables laid in steel conduits, one of which cables is used in case of emergency only. These are connected to the high tension bus bars through two three-pole motor operated Canadian General Electric oil switches. The bus chamber is situated on the ground floor over which is mounted the switchboard and all oil switches. The bus structure is of brick and concrete construction.

The most important and interesting feature of the whole plant is the motor room. This room contains five 2,000 h.p., 12,000 volt, 25-cycle, induction motors running at a speed of 246 r.p.m. direct connected by flexible couplings to five lines of pulp grinders; these motors were built by the Swedish General Electric Company, and supplied by Messrs. Kilmer, Pullen & Burnham, Limited, Toronto, and withstood a puncture test of 2½ times the line voltage. They represent, we believe, the largest motor installation in Canada.

The motor starting panels and starting rheostats are placed opposite each motor on the ground floor. The primary switches, which are magnetically controlled, are situated on the switchboard gallery. In connection with the closing solenoid, of the primary motor switches, there is a small switch on the motor shaft, which makes it impossible to close the main switch should the collector rings be left short circuited through neglect on the operator's part.

The small motors in the mill are all operated at a potential of 600 volts obtained from three 600 kw., 3-phase, oil and water-cooled step down transformers built by the Crocker-Wheeler Company. The feeders are taken underground in steel conduit from the motor room and thence in cleat construction to the various points of the mill.

The pulp is pumped from the grinder room either to a storage tank or to the screens by three centrifugal pumps direct connected to three squirrel cage motors, the storage tank being used during the night when all five lines of grinders are run, thus keeping the day load curve as low as possible.

The sulphite beater and also the broke beater are each operated by a 75 h.p. induction motor connected to the beaters with Renolds silent chains.

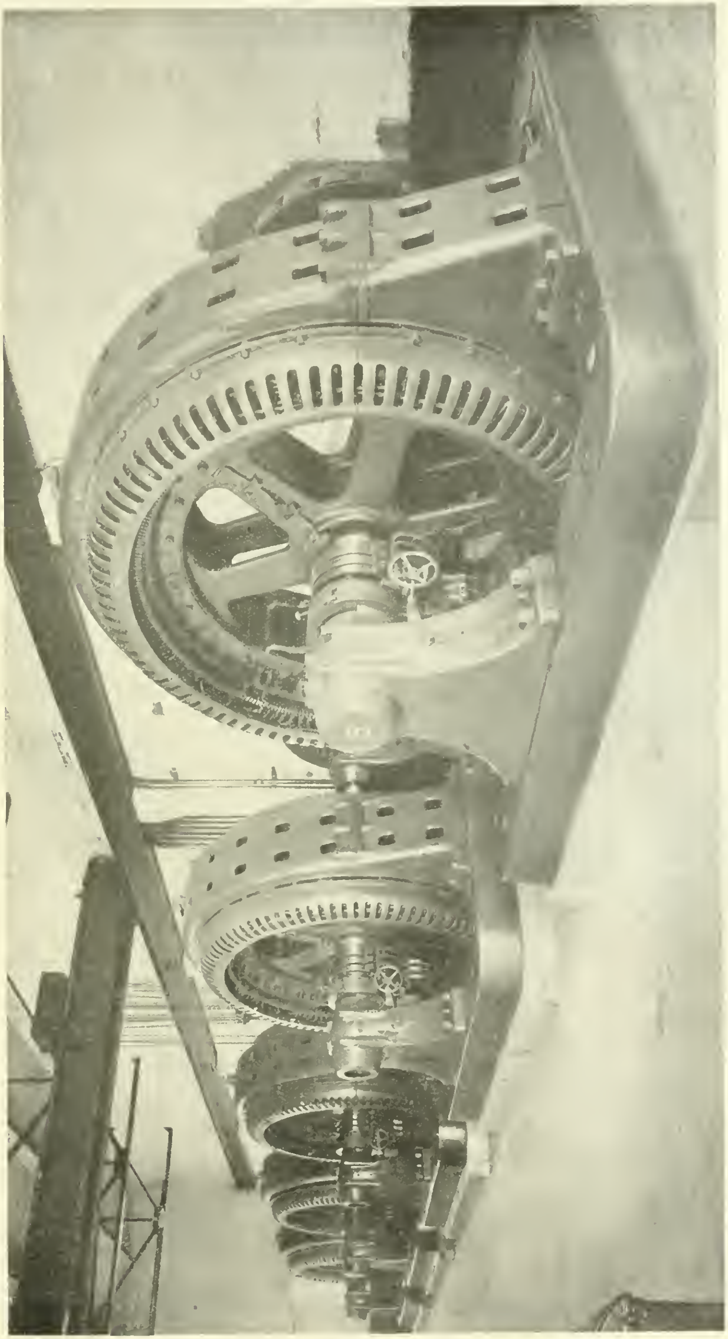
The Jordan machines, of which there are two, are each direct connected to a 150 h.p. auto-synchronous Swedish General Electric Company's motor. All the stock passes through these two machines before passing onto the paper machines.

In the machine room there are two paper machines which are the largest in the world, built by Messrs. Pusey, Jones Company, and are each capable of turning out a sheet of paper 204 in. wide at the rate of 600 ft. per min., or approximately 60 tons each per 24 hours; these machines are driven by two Terry steam turbines running at 150 r.p.m.

The shake on the wet end of the paper machine is driven by motors and so also is the winding gear on the finishing end of the machine.

An interesting feature of the mill is the manner in which the load curve is regulated. This is done by means of a contact making ammeter connected to the main current transformers, which operates an auxiliary relay which in its turn operates a small motor connected to a pressure regulating valve on the water main connected to the hydraulic rams on the pulp grinders. The contact making ammeter is adjusted to the required load according to the number of grinders running. Should this load be exceeded the pressure on the grinder rams is automatically reduced thus cutting down the load on the grinder motors. By this method a remarkably straight load curve is obtained and at the same time all possibilities of running up a heavy peak load are eliminated which is an extremely important item when power is paid for on a peak load basis.

It may be interesting to mention here that a cargo of sulphite was recently shipped direct from Norway to Thorold in the S.S. Glenfoyle thus making Thorold a port for ocean going boats for the first time, which goes to show how electrical developments open up a country, as no doubt the primary reason for the Ontario Paper Mill being where it is, is cheap power.



The largest motor installation in Canada—Five 2,000 h.p., 12,000 volt, 25 cycle, 3 phase, 246 r.p.m. Swedish General Electric induction motors just installed by Messrs. Kilmer, Pullan & Burnham in the mills of the Ontario Paper Company, Thorold, Ont.

Heating of Pipe-Ventilated Machines

By Alex. Gray* B. Sc., Wh.Sc.

When an open motor is totally enclosed, its output has to be greatly reduced in order that the temperature inside of the machine may not be excessive; when, however, a machine is pipe-ventilated, that is, totally enclosed and cooled by blowing cold air through the machine, its output can generally be increased over that as an open motor, for the same rise of temperature in each case. Slow-speed, open type motors, in particular, have poor ventilation and are therefore designed with low copper and iron densities; if totally enclosed, and cooled by forced ventilation, higher densities could be used and the size and cost of such machines considerably reduced.

To determine some heating constants for pipe-ventilated machines, tests were made on the machine shown to scale in Fig. 1. The rating of this machine as an open motor was 80 h.p.; when totally enclosed its output was 25 h.p., and when pipe ventilated was 100 h.p. at the same speed and with the same temperature rise in each case. The machine was a standard induction motor with the yoke and housings cast without ventilating openings and no attempt was made to assist cooling by attaching radiating ribs to the frame. The outlet C, Fig. 1, was connected to a suction fan which drew air into the machine at A. In passing from A to C, the air has to pass through the windings and over the back of the stator core or through the rotor spider. The motor was direct-connected to and loaded by a totally enclosed d.c. generator so that there was no fanning effect caused by a belt.

To determine if there is a law of the form:—Temperature rise $= k \dfrac{\text{watts lost}}{\text{cu. ft. of air per min.}}$

The results obtained from several heat runs are given in Table 1. During these tests, the quantity of air passing

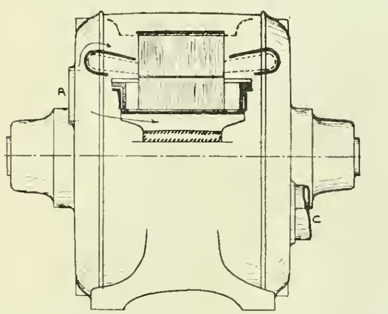


Fig. 1.—Rotor dia., 17 in.; revs. per min., 1180; rotor perip. vel (V), 5200 ft. p. m.; ex. surface of frame, 3750 sq. in.; surface shown heavy, 2.26 sq ft; area of air paths, 1.25 sq. ft.; cu. ft. of air per min., Q(see table); air velocity (ft. per min.) Q/1.25.

through the machine was controlled by throttling the fan discharge; the air velocity was measured by an anemometer placed in the inlet passage, the anemometer being large enough to fit snugly into this passage; the temperatures were taken by thermometers and that of the stator winding was also taken by resistance.

In open type motors, the distribution of the total loss between the copper and the iron has a pronounced effect on the rise in temperature,† but an analysis of the results in Table 1 shows that, for a given current of air passing through the machine, the temperature rise is independent of the distribution of the loss and depends only on the total loss.

The test results are plotted in Fig. 2 and replotted in Fig. 3 in more convenient form. The curves in Fig. 3 are straight lines. It was expected that these lines would pass through the origin but it will be seen that, in each case, they pass through a point P such that, for a loss of .9 kw., there

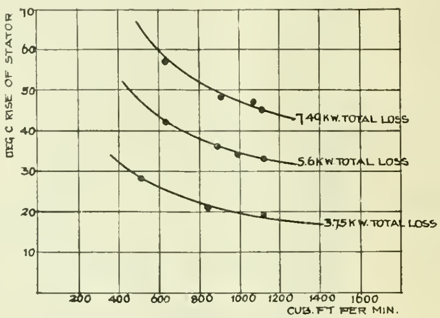


Fig. 2.

is no temperature rise in the windings. The bearing friction loss in the machine was .9 kw. and it would seem that this loss is got rid of by the frame and shaft without having much effect on the internal temperature of the machine.

The curve in Fig. 4 is obtained from the data in Fig. 3; from this curve it may be seen that, even when no air is passing through the machine, a certain amount of heat is dissipated by the frame; in this particular case, 36 watts per 1 deg. C. rise. Previous tests† on totally enclosed machines

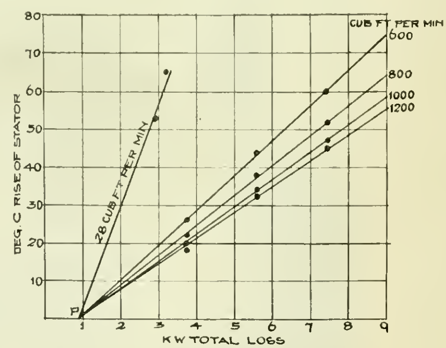


Fig. 3.

showed that the watts dissipated per sq. in. of frame surface for 1 deg. C. rise of the windings $= 0.0044 + 0.0012\ V_1$, where V_1 is the peripheral velocity of the rotating member in 1,000s of ft. per min. The value of V_1 in the experimental machine was 5.2 and the external surface of the frame was 3,750 sq. in. for which values the watts per sq. in. for 1 deg. C. rise = 40 by calculation; this compares favorably with the test result of 36.

* Assistant Professor Electrical Engineering McGill University.

† Gray, Induction Motor Heating, Trans. A. I. E. E. June, 1909.

Analysis of Heating by Forced Ventilation

If T_2 is the temperature of the windings in deg. C.

T_1 is the temperature of the air at the outlet in deg. C.

T_0 is the temperature of the air at the inlet in deg. C.

then, since 1 lb. of air has a volume of 14 cu. ft. and a specific heat of .238, an air current of 1 cu. ft. per min. carries with it .536 $(T_1 - T_0)$ watts.

When air is blown across a heated surface with a velocity of V ft. per min., the watts transferred from the surface to the air for a given temperature difference increases with

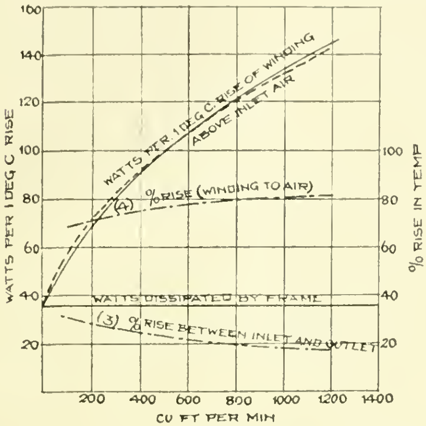


Fig.

the air velocity and with A, the number of square feet of heated surface. In the above tests it was found that

$$T_2 - T_1 = \frac{\text{watts loss}}{1.86 A \sqrt{V}}$$

and since

$$T_1 - T_0 = \frac{\text{watts loss}}{.536\ Q}$$

therefore

$$T_2 - T_0 = \text{watts loss} \left\{ \frac{1}{1.86\ A \sqrt{V}} + \frac{1}{.536\ Q} \right\}$$

where watts loss = total loss — bearing friction — watts radiated by the frame.

Q = the current of air in cu. ft. per min.

A = the radiating surface shown by heavy lines in Fig. 1 in sq. ft.

V = the air velocity in ft. per min. and is equal to Q/ (area of path behind core and through spider).

The curve corresponding to the above equation is plotted as a dotted line in Fig. 4 and checks the test curve closely.

Conclusions

1. The apparatus and the time were not available to enable tests to be carried to extreme limits, and the analysis is of the same degree of refinement as the tests, many corrections such as that due to the effect of the air velocity on the watts dissipated by the frame and that due to the temperature gradient across the frame surface being neglected both in the tests and in the analysis. The following conclusions, however, are of interest.

2. The temperature rise of the windings is proportional to the total copper and iron loss in the machine and is independent of the distribution of this loss.

3. The bearing friction loss has little effect on the internal temperature of the machine.

4. If the quantity of air passing through the machine be increased by increasing the area of the air passages, the air velocity being kept constant, the temperature rise will be reduced but, in most cases, an increase in the air velocity will be more effective; this may be seen from curves 3 and 4, Fig. 4. This statement requires further investigation at high velocities because, at such velocities, the air friction loss and the consequent heating of the air may more than compensate for the increased cooling effect due to the higher velocity; the statement is true, however, up to velocities of about 4,000 ft. per min.

5. The rating of a pipe ventilated motor is very much greater than that of a totally enclosed motor of the same size and is sometimes greater than the rating of the same machine as an open motor.

C. N. R. Telegraph Work

The Canadian Northern Railway Company have just completed their telegraph line between Ottawa and Sydenham and now have a continuous metallic system of telegraph connection between Ottawa and Toronto, the wires being one No. 6 and one No. 8 iron. The company have also under construction 550 miles between Sudbury and Port Arthur which will be composed of two No. 6 iron wires. The company are anxious to have this latter line completed by the new year and the contractors are putting forward every effort to meet their wishes. There are four crews of thirty men each working on this line, constructing at the rate of one mile per day per crew. The above construction work is all in charge of Messrs. Dixon and Gelling, contractors, Ottawa. The same firm will also construct a line between Ottawa and Pembroke.

Table 1.—Figures obtained from several heat runs.

Volts	Amp.	Stat Copper Loss K.W.	Rotor Copper Loss K.W.	Core Loss K.W.	Windage and Friction K.W.	Total Loss K.W.	Cu. Ft. of Air Per Min.	Deg. Cent. Rise of Winding
440	96	1.82	1.56	1.3	.90	5.58	1120	33
440	96	1.82	1.56	1.3	.90	5.58	990	34
440	96	1.82	1.56	1.3	.90	5.58	890	36
440	96	1.82	1.56	1.3	.90	5.58	635	42
440	120	2.84	2.45	1.3	.90	7.49	1120	45
440	120	2.84	2.45	1.3	.90	7.49	1070	47
440	120	2.84	2.45	1.3	.90	7.49	910	48
440	120	2.84	2.45	1.3	.90	7.49	630	57
560	48	.45	.20	2.2	.90	3.75	1129	19
560	48	.45	.20	2.2	.90	3.75	840	21
560	48	.45	.20	2.2	.90	3.75	510	28
250	72	1.02	.86	.42	.90	3.2	28	65
440	48	.45	.25	1.3	.90	2.9	28	53

Co-operation in Electric Vehicle Sales

By E. L. Callahan*

From the view point of the electric-vehicle manufacturer, the principal objects to be attained through co-operation are: the greater satisfaction among vehicle users, the reduction of their operating difficulties and the resulting increased sales, also the vehicle sales made possible by the good example established in the use of vehicles by the eleceric-service companies and because the service companies are in a position to advise the manufacturer of live prospects for the purchase of electric vehicles.

From the viewpoint of the electric-service company, the advantages to be realized are:

The promotion of the sale of electricity, thereby increasing revenue.

Improved operating conditions; i.e., through obtaining a considerable "off-peak" charging business the central-station load-factor is improved, and the cost of production reduced.

Advertising; the service company feels that every electrically operated machine, be it an automobile or a buzz-saw, is an advertisement instrumental in bringing new customers to its lines.

Furthering the interests of the industrial and social progress of the communities in which the central-station company operates, for any improvement in civic welfare is ultimately reflected to the service company either in improved surroundings and aesthetic betterment, or in good, round dollars.

These are the chief reasons for co-operation, I believe, and are worthy of consideration.

Fundamentally, there appears to be only one logical point of contact between the electric-service company and the electric-vehicle user, that is, the sale of current for charging. Is it not rather strange that the central-station companies are asked to render assistance in making the sale of a machine in which they are interested in only one item of its operation? The total annual cost of current for operating electric vehicles is seldom as high as 10 per cent. of the total annual cost of owning and operating same. Can the central-station company, therefore, be expected to carry any great amount of the burden when it receives less than 10 per cent. of the money spent by the customer? Do the gasoline manufacturers lend any material assistance in the sale of gasoline cars? The gasoline manufacturers receive a far larger part of their total revenue from automobiles than do the electric-service companies! However, the electric-service companies are vitally interested and will co-operate with the vehicle manufacturers, thereby doing their part in advancing the electric-vehicle business to the mutual advantage of all concerned.

From the customer's viewpoint, the most conspicuous advantage accruing from the use of electric vehicles are: the ease, convenience and graceful luxury of the pleasure vehicle; the low operating expense, increased radius of operation and general fool-proof construction of the truck, and of both the simplicity and freedom from breakdown, the absolute reliability and the avoidance of expensive attendance.

What can the service companies do to emphasize these characteristics or bring them more forcibly to the attention of the public?

First, by setting a good example. I understand that the Commonwealth Edison Company of Chicago has about 100 electric trucks and is greatly pleased, not only with their performance in delivering material and for general transportation purposes, but equally well with the advertising gained by their use.

It often occurs that, in buying automobiles for electric-service company use, the choice of cars is left to the discretion of the purchasing agent, superintendents, or men not directly interested in the development and increased output of the company. Therefore, in selling electrics to central-station companies, the salesman should go to the manager and to the commercial department and to the men who are interested in advancing the welfare of the company and the city—not alone to the prospective operatives of the machine, who, perhaps, are more interested in the joy rides they may be anticipating or the noise they may be able to make with an open exhaust in a gasoline car. From the viewpoint of a driver, an electric may have advantages over gasoline cars or over horse-drawn vehicles, or it may not, but from the viewpoint of the man selling electricity and responsible for the advancement of the use of electricity, there is no alternative but the electric vehicle within its proper sphere of proven usefulness.

Second: there is the consideration of cost of operation. A great deal of comment (to use a mild term) has been made relative to the failure on the part of electric-service companies to lower their rates for current to charge electric vehicles. It has been urged that the excellent character of this load and the assumed inexpensiveness of producing such service have been ignored. There are probably some service companies charging rates out of proportion to the cost of this service; however, these are among a fast-declining minority, and they are gradually coming to a realization of the advantages of proper rates.

Current cost not a large faetor

Let us see what advantages may be derived from lower rates for charging. I find that the cost of practically every other commodity incidental to the vehicle industry is increasing in price—and, as an example of this, I would mention gasoline—while the cost of electricity has been lowered, not slightly, but, in some cases, as much as 50 per cent. In arguing for lower rates, it is cited that the vehicle-charging load is an "off-peak" load, and so makes no demand upon the central-station's capacity. This is largely true and deserves careful consideration, but, on the other hand, the service company's investment is not only in generating equipment, but also in lines and transformers, and the amount of such investment is often about equally divided between the generating plant and distributing system, including transformers, meters, etc. A garage requires just as much capacity in lines and transformers as any other load of similar size, and, in the case of private garages, the line requirements are often very much heavier than for other customers using a like quantity of current, notwithstanding the "off-peak" character of the load. Under such circumstances only a slight reduction in rates, if any, below those charged for other classes of service is justifiable.

A recent study of rates in a city of 325,000 inhabitants resulted in the establishment of a rate for charging of 3.8 cents per kilowatt-hour for the first 1,000 kilowatt-hours, and reduced thereafter for larger consumptions. But after all, what inducement does reduction in rates hold out to vehicle users? From various sources, including the classic work of the Massachusetts Institute of Technology, the Report of the School of Mines of Columbia University, and others, it is found that the cost of current for charging is very seldom as high as 10 per cent. of the total cost of operation,

*Presented before the Electrical Vehicle Association Convention.

including proper interest and depreciation charges, and by proper depreciation charges I do not mean the exorbitant rates that may grow out of the mind of some warped economist, but the rates adopted by the most eminent authorities. The cost of current for charging being, therefore, less than 10 per cent. of the total cost of average trucking work, a 20 per cent. reduction in the price of current would mean less than a 2 per cent. reduction to the vehicle user in the cost of operation—truly an insignificant portion of the total expense.

Should Central Stations be active in selling

It has often been suggested that electric-service companies should take an active part in the sale of electric vehicles, that they be displayed in showrooms, demonstrated by the selling force and advertised as are other current-consuming devices. It has often been suggested that central stations might well abandon the electric flatiron, with its "insignificant consumption" and turn their energy to the sale of electric vehicles, "using many times as much current." In discussion of this suggestion, I would say that the sale of a flatiron increases the company's annual revenue by almost three times the price of the iron, while the electric vehicle increases the annual gross by only about 6 per cent. of the selling price of the vehicle, that is, a flatiron selling for $3 will produce an annual revenue of $8, while an electric truck selling for $3,000 results in an average annual revenue of only about $175. A flatiron produces a revenue equal to its original selling price in about 4½ months, while an average electric truck requires about 17 years and a pleasure vehicle about 25 years.

Another excellent reason for the service company not going into the automobile-selling business is that it is too foreign to the business of the company, requiring a separate organization and, not naturally falling in any wise within the scope of the service company's functions. It may often occur that the central station has a garage for its own machines and may find it expedient to care for a few other vehicles; in that case, if the business is found profitable and works no hardship upon independent garages, it is certainly a commendable plan, but such a garage might equally well have been established and operated by any other interest. Likewise, if the service company finds that it can sell machines as a profitable business and without interfering with its patrons, all well and good, but the central station should not be asked to sell or provide garage facilities for electric vehicles with the expectation of a profitable return from the increased electric revenue.

It has often been urged that service companies might do extensive advertising and sales work in co-operation with the electric vehicle manufacturers. A great many service companies are doing this on a large scale, but let us see how far they should go into this matter. A live central station interested in developing its business, today spends about 2½ per cent. of its gross revenue in soliciting and advertising, or, it is found to be necessary in getting business and in advertising, to spend about 25 cents for each $1 of increased annual revenue. On the same basis, the central station would be warranted in spending about $45 in obtaining an electric-vehicle customer. This includes the advertising and soliciting of unproductive prospects, as well as actual purchasers, and is based upon the revenue from a commercial vehicle. Considering the revenue from a pleasure vehicle, estimated at $80 per year, the permissible expense for advertising and soliciting becomes about $20. It is quite possible that when the desirable nature of this load is fully realized and the advertising incidental to the use of the electric vehicle and the general improvement in commercial and civic conditions is taken into consideration, that central-station companies might be warranted in spending as much as $60 for each commercial truck and $25 for each pleasure vehicle placed.

It should be remembered that part of this expense is necessary after the sale is made in arranging for contracts for service, purchase of charging equipment, etc. This probably seems like a small contribution when compared to the efforts made by the electric vehicle manufacturers; but there is another side of this question. The actual amount of money which the electric-service company appear to be justified in spending would not be a fair measure of its effort toward the larger sale of electric vehicles, for service companies have complete working organizations in close touch with every industry in their respective cities and are already doing business with practically every industry. The electric-service companies have the confidence of their customers, and their representatives are looked upon and referred to as authorities on related commercial and engineering questions. More, by far, can be accomplished in the advancement of the use of electric vehicles through these representatives than with the same expenditure of energy through any other channel available to the central station.

I will undertake to outline a plan of co-operation in the form of a few well-meant suggestions addressed to the vehicle manufacturers.

First. Do not waste your time in an effort to obtain a reduction in electric rates; the entire elimination of the cost of current for charging would result in a saving of only 10 per cent. of the total expense of operation and ownership.

Second. Do not expect the central station to sell your cars for you, or to spend unreasonable sums of money in advertising electric vehicles. Do not urge the displacement of revenue producers that are, at present, many times more effective, to make room for electric vehicles.

Third. Do not expect the electric-service company to go into the garaging business for the purpose and with the expectation of obtaining the profit of the business from the sale of current.

To urge any of these measures will only waste your time and that of the central-station manager, and delay genuinely productive co-operative efforts.

Suggestions

In the foregoing, I do not want to be over-critical, but there has been so much unfounded criticisms of the central stations because of their "failure to assist the electric-vehicle manufacturers," that I believe my statements have been warranted. I believe that many electric-service companies have been very slow to take up and push the sale of electric vehicles as it should be pushed, and that, thereby, they have failed to grasp an excellent opportunity to co-operate with you to mutual advancement. I now wish to offer a few suggestions, which, I trust, may lead to better co-operation and speedier recognition, on both sides, of the benefits to be derived therefrom.

First, there are about 1,500 copies of the Electrical Salesman's Handbook, published by the Commercial Section of the N. E. L. A. (new sheets for which are issued quarterly) in the hands of as many central-station power and lighting solicitors, each daily calling on the manufacturing companies and other big industries in his city. This loose-leaf book contains accurate data on the consumption of current, and a description of the application of electric power to the various miscellaneaus industries. The book is very instructive, highly esteemed and constantly referred to by both the solicitors and their prospective customers in determining the merits of electric power. Only a limited amount of data on the subject of electric vehicles is contained in the book at present. It should contain a great deal more and of a very comprehensive nature. An immense quantity of such data is available, but has never been offered to the Commercial Section. The Commercial Section recommends, therefore, that the Electric Vehicle Association appoint a committee to collect the most reliable and dependable data available, showing the cost of operating electric vehicles in various

classes of work, the saving and increased efficiency that may be effected, giving briefly the information required by a prospective customer in making an intelligent decision in solving his transportation problems. This data, if properly compiled, will be recommended for publication and distribution by the Commercial Section to its membership.

Second. Under present conditions, I believe you will agree with me that only a very small part of the advance information received by vehicle manufacturers concerning prospective purchasers of vehicles originates from central stations. The exact reverse should be true. I would recommend, therefore, that in approaching central-station companies the manufacturers urge that the central-station representatives—new business men especially—be instructed to report all prospects which come to their attention. These men spend practically all their time among the very people that the manufacturer is trying to reach and should be able to render considerable assistance in giving advice to prospective vehicle purchasers.

Third. A great many electric-service companies credit their commercial men with contracts signed and so rate them for promotion, advances in salary, etc., and, in some cases, give them a monetary commission for such contracts. I do not, however, know of any company crediting its men with the placing of electric vehicles. In central-station work, the greatest credit is given the solicitor or salesman who displaces or prevents the installation of an isolated plant. Then why should not the salesman have credit for placing an electric vehicle, which surely displaces an isolated plant—a gasoline engine of from 20 to 75 horse-power capacity? I earnestly recommend that the central station be shown that just as much credit should be given for the placing of an electric vehicle as for a contract for any other power of similar character. True, the central-station company now gives its salesmen credit when a rectifier or charging equipment is contracted for, but it should be remembered that the revenue is not proportional to the number and capacity of rectifiers or charging equipments installed, but to the number of machines charged, whether they be charged in individual private garages or all at one place. The giving of proper credit to salesmen by central stations for the sale of, or for being instrumental in the sale of, electric vehicles will be equivalent to the addition of several thousand vehicle salesmen to the forces now at work in the field.

Fourth. Wherever such a step is feasible, it should be recommended to central stations in the cities of medium and small size that an inspection department be maintained for the purpose of examining vehicles without cost to consumers and giving owners whatever technical advice they may desire. This cannot be made a general recommendation, because I do not believe that it applies to all central stations or communities, and would be unwarranted and impracticable in large cities.

Fifth. For the purpose of instructing and educating central-station employees in the construction and operation of electric vehicles and in the advantages to be derived from their use, that the manufacturers co-operate with the central stations by offering a brief course of instruction, preferably at the manufacturer's plant. This should compare, on a small scale, with the lecture courses now offered by the large manufacturers of electrical machinery. In many cases, it would be found more expedient to have the manufacturers' representatives co-operate in person with the sales department and central-station employees on the ground and actually in the field of operation.

In concluding, I wish to invite the frankest possible comment and criticism and to ask that any and all suggestions that you may have to make on this very important subject be offered freely and fully. I can assure you, speaking for the Commercial Section of the National Electric Light Association, that the progressive electric service companies are willing and anxious to co-operate with you in every feasible way for the advancement of the electric-vehicle industry and that they will be only too glad to take up and adopt any reasonable suggestions that are offered and to meet you more than half way.

Personals

Mr. P. Whitfield has been appointed electrical superintendent for the town of Battleford, Sask.

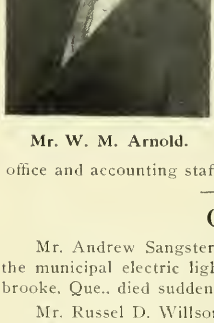
Mr. S. L. B. Lines, general manager of the Chamberlain & Hookham Meter Company, is spending a few weeks in Western Canada.

Mr. A. B. Coryell has been appointed general superintendent of the Moncton Tramways, Electricity & Gas Company, succeeding Mr. Price, who has been transferred to the Pittsburgh office of this company.

Mr. R. W. Bruce, of London, Eng., has been appointed general superintendent and chief engineer of the Canada Electric Company, Amherst, N.S., and also will have charge of the electrical equipment of the Maritime Coal, Railway & Power Company at Joggins Mines.

Mr. F. K. Martin, for the past five years electrical superintendent for the town of Battleford, Sask., has accepted the position of electrical superintendent for the town of Humboldt, Sask., his new duties to commence on December 1. Mr. Martin was previously electrical superintendent for the Canadian Ship Building Company.

Mr. R. Sidney Imray, outside engineer of the Siemens Company of Canada Limited, has just left Nova Scotia, where he has been putting up the various electric hoisting engines and turbo-generators supplied by his company to the coal companies in that district. He is now proceeding to British Columbia to take charge of the erection of large electric hoisting engines for the Canadian Collieries.



Mr. W. M. Arnold.

Mr. W. M. Arnold, who for the past 18 months has been purchasing agent for the Ottawa Car Company has been appointed assistant manager, succeeding Mr. W. K. Jeffrey, who was made general manager some months ago. Mr. Arnold in addition to his new duties will, however, still act as purchasing agent for the company. Another promotion, or rather addition, to the staff is that of Mr. H. T. Burpee, who has been bookkeeper for the past eighteen months for Ahearn and Soper, Limited. Mr. Burpee has been appointed controller of the office and accounting staff for the Ottawa Car Company.

Obituary

Mr. Andrew Sangster for many years superintendent of the municipal electric light department of the city of Sherbrooke, Que., died suddenly at his home on November 9th.

Mr. Russel D. Willson, assistant city engineer of Winnipeg, Man., met his death by accidental electrocution, in the well house at City Well No. 18 about ten miles north of the city of Winnipeg, on November 17th. Mr. Willson was a graduate of the Faculty of Applied Science and Engineering of the University of Toronto, in the year 1901.

Testing of Telephone and Telegraph Lines

By Mr. T. H. Nicholson

The Voltmeter Shunt Coil (Con.)

This table may be extended to include the resistances indicated with a 100 volt shunt as well as the 1000 shunt and may also show the probable distance to the trouble under various conditions. By these means a good deal of valuable time can be saved, and more uniform results obtained.

The High Resistance Voltmeter

The 30 volt scale instrument is generally the best for local testing, but on toll work, and occasionally on local work, a higher voltage is necessary. It is true that a 30 volt instrument can be obtained with a higher internal resistance, and this makes possible the measurements of higher resistances than can be done with the usual meter, which has a resistance of from 1000 ohms to 5000 ohms, depending on make and scale arrangement.

This high voltage is rarely required, however, in local testing, and as the low resistance instrument is more adapted to general needs than the higher, it is often found desirable to combine the two. This can be done by obtaining an instrument with double scales, one for 30 volts and another for 100 volts. If a low resistance voltmeter is already in use it can readily be converted to the double scale type by adding resistance to its circuit. The method of doing this is shown in Fig. 14 which illustrates a 30 volt instrument having a resistance of 1500 ohms. A key is arranged to insert an additional battery of 70 volts, and an additional high resistance, directly in series with the voltmeter, regular battery and test circuits. The added resistance must of course bear the same ratio to the added volts as the original resistance does to the original volts, so that the added resistance is

$$\frac{70}{30} \times 1500 = 3500$$

The method of determining the external resistances in-

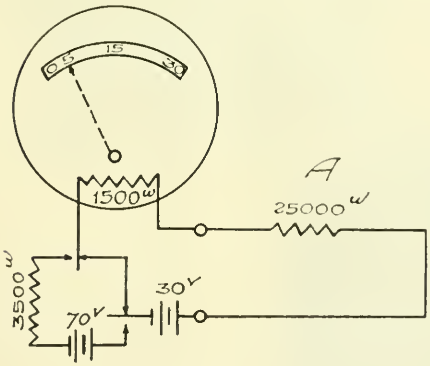


Fig. 14

dicated is just the same as for the regular meter and as given above, and applying this, the resistance "A" is found to be 25,000 ohms when the voltmeter shows a deflection of 5.

By the use of this arrangement a definite standard of line insulation can be set and maintained without the necessity of elaborate bridge measurements.

Choice of Voltmeter for Testing

It is necessary to exercise a little care in the selection of voltmeters for testing purposes. Inasmuch as an instrument used under these conditions has its moving element very frequently operated, its bearings or pivots should be of the best quality, and so arranged that a permanent adjustment is assured. In addition to this it should be as nearly dead-beat as possible—that is, the needle should come to a dead stop when the point of maximum deflection is reached. This is in order that the operator does not have to wait for it to come to rest after each change in the circuit, as is the case with some instruments. Then again for ballistic tests the instrument must be absolutely dead-beat, not nearly so, otherwise it is impossible to determine the capacity of a line, or the number of condensers across it.

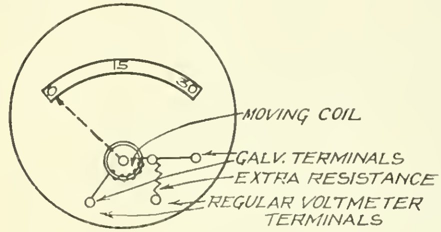


Fig. 15

The resistance of a voltmeter is not, as is often supposed, contained entirely in the moving element, in fact very little of the resistance is represented in the actual instrument. This fact makes possible the arrangement shown in Fig. 14 where by adding resistance in series with the circuit, a higher scale instrument is obtained. The armature of the voltmeter has a small winding usually less than 100 ohms, and the rest of the resistance is simply a resistance coil mounted inside the case.

When it is desired to use the voltmeter as a galvanometer, as later described, it is necessary to cut out this extra resistance, and use only the armature, or moving element of the instrument, for this purpose. Therefore it is advisable to obtain instruments with which this can readily be done. Fig. 15 shows how this is usually accomplished, and also how the average voltmeter is arranged.

Mr. J. E. Brown, superintendent of the Ottawa Municipal Electric Commission, recently reported to Mayor Ellis that some of the underground electric cables owned by the commission are being affected by electrolysis caused by current from the rails of the street railway. Representatives of the Ottawa Electric Company, the Ottawa Electric Railway Company, and the Bell Telephone Company took the matter up with Mr. Brown and after some discussion it was decided to allow officials of the Ottawa Electric Railway Company to make a survey of the whole street railway system in the city and report the results at another meeting to be held in a month's time.

Mr. Brown submitted a piece of cable taken from a manhole in the centre of the city, on which the sheath had been affected by electrolytic action. The damage was done where the cable lay on the iron hook at the side of the manhole. Mr. A. A. Dion, general manager of the Ottawa Electric Company, stated that he had made a general survey of the city, but he had not found conditions as Mr. Brown had reported.

Plans are reported as in progress on a telephone exchange to be built by the Bell Telephone Company on Eccles Street, Ottawa, at a cost of $25,000.

Electric Railways

Mount Royal Equipments

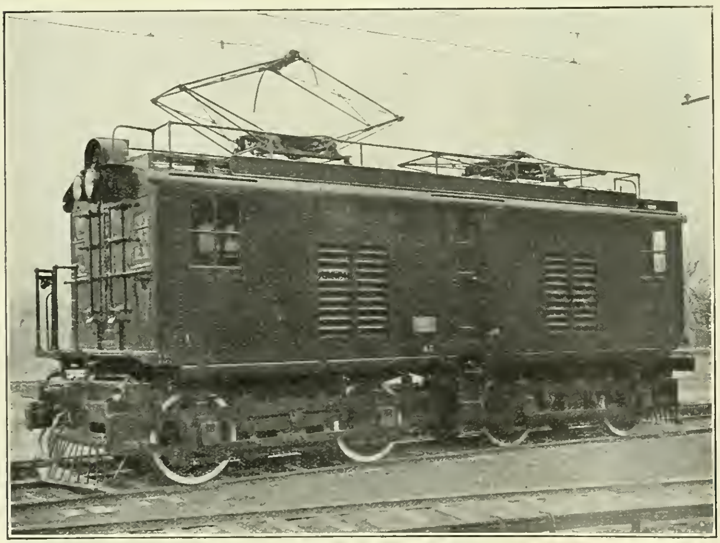
The tunnelling of Mount Royal by the Canadian Northern Railway Company, in order to reach a terminal in the centre of the City of Montreal, was a daring conception, and it was rendered practicable only by recent improvements in the electric locomotive. Considerations of cleanliness and health pointed to the necessary use of electricity as the motive power in the tunnel and it will therefore be interesting to describe a few features in the design of the locomotives selected for the work.

The equipment for the electrification of the tunnel and terminals, for which the Canadian General Electric Company, Limited, have the contract, includes six electric locomotives designed for an operating potential of 2400 volts, direct current, with overhead trolley construction, which has been adopted as the C. G. E. standard for service of this sort. Two of these locomotives, operated and controlled as a single unit, will have ample capacity and suitable speed requirements for handling the heavy transcontinental passenger trains—1130 tons trailing load—within the Montreal terminal zone. A single locomotive will successfully handle the freight trains—1000 tons trailing load—and the local passenger service—500 tons trailing load.

Locomotives

The general type of the locomotive proposed is that known as the Box Cab—Articulated running gear type. The estimated weight of the complete locomotive is 83 tons. The locomotive has four axles with all of the weight of the locomotive evenly distributed over the eight driving wheels, thus securing the maximum adhesive weight on drivers. The running gear consists of two four-wheel trucks, articulated together by a heavy hinge. The equalization of the trucks is accomplished by a heavy locomotive type semi-elliptic leaf spring over each journal box, connected through spring hangers to the frame and to the equalizer bars. Practically a three point suspension is thus supplied through the side equalization of one of the trucks and both side and cross equalization of the other truck. With the Miner friction draft gear mounted in the end frame casting of the truck, this type of construction restricts the hauling and buffing stresses to the truck side frames and articulated joint, instead of through the cab centre plate. This relieves the cab and apparatus from the effect of severe shocks.

Both the box cab and platform are built of plates, sheets, angles and heavy channels and are thoroughly reinforced throughout. The box cab is divided into three compartments; the apparatus compartment in the centre and the two operators' compartments at the ends. Each operator's compartment has a full complement of apparatus, consisting of controller, control switches, meter, air brake control apparatus, air guages, pantagraph control and heaters, thus providing the locomotive with a complete double end control. All apparatus subject to 2400 volt potential is located in the centre apparatus compartment and properly screened to protect against accidental contact. The location and general arrangement of this apparatus is such as to provide easy access from all sides for inspection, cleaning and repairs.


Side view of Locomotive to be used on Mount Royal Tunnel line

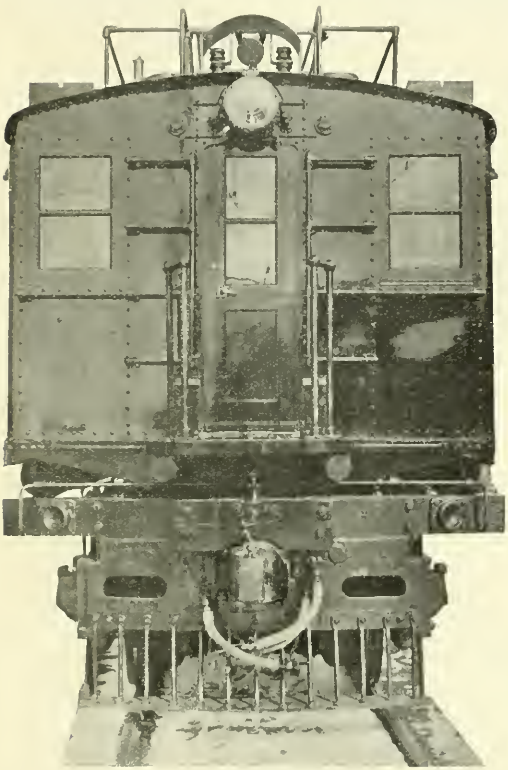
Control Equipment

The well known Sprague-General Electric Type "M" multiple unit double end control equipment is proposed for the locomotives, all the control points being proportioned and adjusted so as to secure a smooth and even acceleration at all times, corresponding to a current consumption near the slipping point of the wheels. The transition between series and series-parallel is effected by a special electro-pneumatically

operated change-over switch and the motor fields will always be on the ground side of the armature.

A motor generator set will supply 125 volt energy for the operation of the control, and a 2400 volt air compressor of 100 cubic feet free air piston displacement is provided as part of the air brake equipment. Two air operated roller pantagraphs and a properly insulated bus line are located upon the roof. The bus line will supply power to two or more units from the pantagraphs of any of these units.

The motor equipment consists of four C. G. E. 229 commutating pole type motors wound for 1200 volts and insu-



End view Mount Royal Locomotive.

lated for 2400 volts, so that two may be connected permanently in series and operated on a 2400 volt circuit. These motors are geared to the wheels through twin gears, there being one pinion on each end of the armature shafts. This motor is specially designed for locomotive service and is provided with forced ventilation by a blower located in the apparatus compartment. The locomotives are geared for a free running speed on tangent, level track of approximately 45 miles per hour and will be operated as two-speed machines with ten points in series and nine points series-parallel.

The air-brake equipment will be the straight air and automatic type so as to combine the desirable features for train operation through an equalizing reservoir and the independent operation of the brakes upon the locomotive. Provision is made for the multiple operation of the compressors upon all locomotives when operating in multiple so as to distribute the duty upon all the compressors in the train.

Operation of Motors

The motors will be operated by the Sprague-General Electric Type "M" two-speed control arranged to operate the motors in series and series-parallel. The external regulating resistance is divided into two parts, each part being direct connected to a pair of motors permanently connected in series. The two pairs of motors, with their resistances, are all connected in series on the first point of the control, the resistance being varied through the first nine points on the controller and finally short circuited on the tenth, or running point. The two pairs of motors are then similarly operated in series-parallel and all resistances cut out on the last or full-speed running point.

A special electro-pneumatically operated change-over switch is used to make the transition between series and series-parallel so that there will be no appreciable reduction in tractive effort during the change. A smooth transition between all points, both rheostatic and transitional, insures motor operation close to the slipping point of the wheels and a steady, gradual acceleration at all times.

The motors have sufficient capacity to slip the wheels, the slipping point serving as a current limit to prevent overloading. Either pair of motors may be cut off, in case of emergency, by means of a special handle on the change-over switch.

Controllers

The master controllers receive their energizing current at a potential of 125 volts from the motor-generator set and provide for operating the contactors so that they close the motor circuits under different combinations and regulate the external motor resistances to give 10 points series and 9 points parallel. The controller is of the non-automatic type and has two handles; one regulating the applied voltage at the motors and the other for controlling the direction of rotation of the motors. Each of the above handles controls a single cylinder.

Pantograph Trolleys

The overhead trolleys are of the pantograph type mounted on insulated bases and pneumatically operated. A hand pump is provided for raising the trolley in case a locomotive has been standing some time and has no air supply.

Automatic Stops

Provision is made for automatically opening the control circuit and cutting off all power from the locomotive, in case the engineer overruns a signal set against him. At the same time a special valve is opened which will set the emergency air brake. The equipments of the motor cars required for this service are also an interesting feature and will be described later.

Subways for Montreal

As the result of further negotiations between the Montreal Tramways Company and the City Council, the former have submitted a scheme which, if carried out, will revolutionize the entire transportation system. It involves the expenditure of many millions by the company and the city. The feature of the proposals is the construction of three underground subways, one almost the entire length of the city north and south, a second east and west under St. Catherine Street, and a short one in the business section. The fare is to be 5 cents straight. The expense of the construction is to be borne by the company, but the city is to guarantee the necessary mortgages to be issued by the company. Subways are also to be built under railways and canals, the company to pay half interest and sinking fund.

It is proposed that a new artery should be opened between Place Viger and Windsor Station, and a boulevard constructed north and south; steps are also to be taken to

widen Vitre Street from St. Denis Street to Victoria Square. The company are prepared to run a motor-bus service, for a 5 cent straight fare, and to run a freight service on the cars at night.

With regard to all surface improvements, the city and the company are to agree that the city supply the streets and the company do the construction work. In exchange for these improvements, the company desire a 40 years' franchise, all existing franchises to be surrendered. The city is to have the right to acquire the system as a going concern at the end of the 40 years by giving 12 months' notice; failing that notice, the contract is to be automatically renewed for periods of ten years. It is also asked that the present percentage of earnings paid to the city be at a uniform rate of 4 per cent. instead of on a sliding scale.

According to Mr. Robert, president, the company will have expended about three million dollars this year in betterments. The intersection rails are superior to those of any other railway system on this continent, and the road bed is absolutely permanent or as near so as the streets of Montreal will allow. In Mr. Graves the company have one of the best engineers in his line on the Continent.

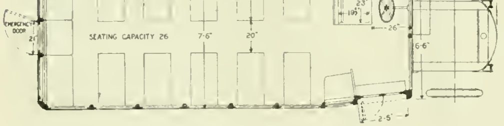
The Canadian Autobus Company have also submitted to the Council competitive proposals for subways.

Twenty-Six Passenger Omnibus

As a feeder to trolley lines and as a means of transportation in sections not served by electric railways, the motor omnibus has no equal. A 26-passenger bus, built by The J. G. Brill Company for the Utica Lines of the New York State Railways, is being used for this purpose, and is at present in service along the New York State Highway between Utica and Sauquoit, a village about ten miles distant. The conditions in this section are ideal for motor bus operation, as there are a number of important manufacturing establishments employing large numbers of hands in the district which, at present, is wholly unsupplied with trolley service. Then, too, the condition of the State Highway permits good running time with none of the racking so common on the ordinary country road.

The bus just delivered is mounted on a special three-ton Mack chassis equipped with Westinghouse air springs at the front and rear. The underframe is formed of the usual side and end sills, properly reinforced, and has as its most interesting feature seven crossings formed of 3-in. channel steel, which are placed with the web in a vertical position, with ash crossings between on which the floor is laid. The use of 3-in. channels in this position reduces the weight of the underframe without taking from the strength.

Door and step arrangements are out of the ordinary in



Plan of 26-passenger motor bus.

this type of vehicle, and permit the utilization of practically the full width of the floor. This is accomplished by means of a two-leaf folding door operated by a lever mechanism at the driver's left hand. This door closes against the edge of the top step tread and the lower step folds up even with the bottom edge of the door. The location of the driver's seat on the left-hand side of the bus, directly opposite to the door, permits of one-man operation, a decided advantage in service of this character.

Standard trolley car practice is followed very closely in the interior fittings. The finish is of ash with maple veneer ceiling. There are 10 transverse seats of Brill manufacture, built without cross frames under the cushions. The pedestals at the aisle ends, together with the cushion supports and seat-back braces, are made of pressed steel in one piece. This method gives strength combined with light weight and facilitates cleaning. Curtains and fixtures, sanitary hand-straps, push-button signal system and seat-back grab-handles are such as are used in regular trolley car equipment. A transverse seat running across the entire rear end of the bus, rattan upholstered like the others, has a removable center-section which gives access to an emergency door.

There are two double sash windows in front, which are particularly interesting in that the lower sashes are stationary while the upper sashes are hinged at the top to open outward. A glass hood, placed at the top of the lower sash in front of the driver, prevents rain or snow from obscuring the section of glass in the line of his vision. All of the side windows have stationary upper sashes, but the lower sashes are arranged to raise. Ventilation is further provided for by four slat ventilators placed two on each side. A single electric headlight is placed under the front projection of the plain arch roof. A row of electric lamps set on either side of the ceiling provide for illumination at night. The bus is heated from the exhaust of the engine. The dimensions of the bus are, roadway to side sills, 3 ft. 2¾ in.; side sills to roof, 7 ft. 2¾ in.; floor to headlining 6 ft. 7¾ in. Roadway to bottom step, 18⅜ in.; bottom to top step, 13 in.; step to floor, 13 in. Weight of body, 3,750 lb.

Britannia Line not Paying.

The Ottawa Electric Railway gave formal notice a few days ago that on and after December 1st an extra fare would be charged to all passengers riding from Holland avenue, the western limits of the city, to Britannia and intermediate points. As a result of an application filed with the Railway Commission, on behalf of the city by Mayor Ellis, asking the Commission to investigate the tariffs of the company and its refusal to make any further extensions of the street railway system in the city before the expiration of the company's franchise in 1923, an order has been issued preventing the increased rates from going into effect before January 1st.

In the meantime arguments for and against the application will be heard by the Railway Commission on a date yet to be fixed. There is a great deal of public interest being manifested over the proposed action of the company, whose directors state that the reason for their action is that the Britannia line is not paying and has not paid for some time.

The O. E. R. has $750,000 invested in the line in question and since the one fare from any part of the city to Britannia, a distance of about six miles from the centre of the city, has been in effect, the receipts have not been sufficiently large to pay the fixed charges, which total annually about $50,000. Though the street railway system as a whole is a paying concern the directors are of the opinion that the Britannia line, which was a separate investment should be put on a paying basis. When the line was opened in 1900 an extra fare was charged from the city limits, but even then did not pay. Five years ago the extra fare was abolished and a fare or transfer from any part of the city was honored on the line and this, too, has proven unprofitable. During the past five years, however, the district through which the line runs has become fairly well settled, but the increased traffic has not brought as large a volume of business as hoped for.

Illumination

Principles of Illumination

III. Absorption

One of the biggest stumbling blocks in the way of efficiency in illumination is "absorption" of the light. Whenever the rays come in contact with a reflecting or refracting material a certain amount of light is destroyed, this amount varying with the material but running often as high as 50 per cent. To understand the real meaning of absorption it is necessary to mention a few facts in connection with the theory of light.

Light is a form of energy, just as heat is, and is carried from its source to the object illuminated by waves of ether. It follows therefore that if we destroy these waves we at the same time extinguish the light. The waves will pass quite freely through clear glassware but a large percentage are killed by frosted, ground or colored glass. Dark or rough

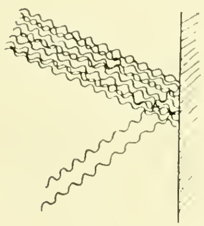


Fig. 1.

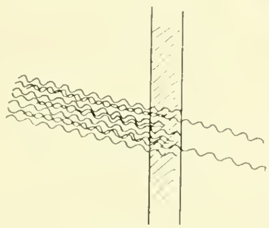


Fig. 2

surface walls have the same effect. The destruction of waves at either a poor reflecting surface or in an ordinary refracting medium may be represented as in Figs. 1 and 2. It will thus be seen how important it is to decorate our rooms having in view a proper and efficient illumination. We would not expect great efficiency using an indirect unit with a dark or rough ceiling; nor is efficiency possible if we surround the light source with a semi-opaque globe. The better distribution and more artistic effect obtained in this way must always be at a greater expense for current.

More Light for Galt

The town of Galt has just added a number of handsome ornamental standards to their street lighting equipments, samples of which are shown herewith. Figure 1 represents the type of standard used on Dixon street, of which five more have just been installed. Figure 2 represents the type of one light standards installed on Oak street and on Blair Road to the extent of about 70 units. It is expected that the latter type will be used in further extensions along this road as far as the town limits. Galt is also trying out a number of combination trolley and tungsten standards which are giving excellent satisfaction. These standards are 22 ft. high and carry, at a point approximately 12 feet from the ground, 4 spherical globes containing 100 watt tungsten lamps. The poles thus extend about ten feet above the lamps and are used to sustain the cross wires from which the trolley wire is suspended. These combination poles are also to be used for transmission poles, in Galt, by the addition of two steel cross-arms which will carry the 2300 volt distributing wires.

The ornamental standards are fed by underground work. These consist of three wire No. 4 B & S cable, jute insulated

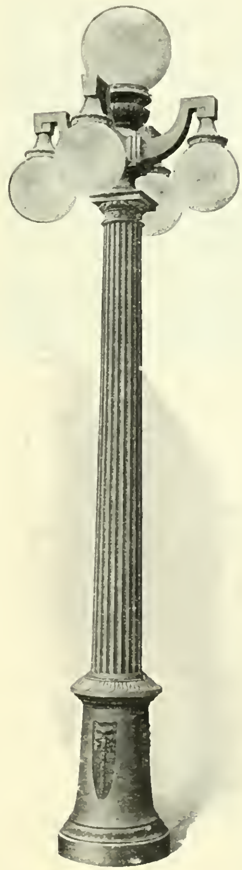


Fig. 1.

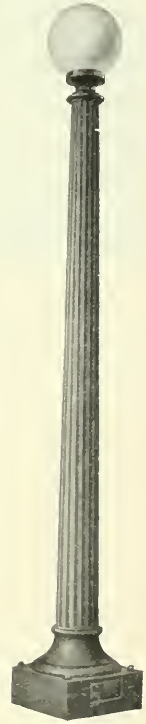


Fig. 2.

and lead covered. The cable was supplied by the Johnston & Phillips Company, of London, Eng. The cable is in turn enclosed in 3-inch diameter fibre duct, which in turn is laid in cement about 30 inches below the surface of the roadway, close to the curb. All lamps are connected in multiple and

remote controlled by time switches located either in manholes or on wooden poles situated in side lanes. Secondary distribution is at 110 volts, 3 wire single phase, all transformers being placed underground in 5-ft. x 6-ft. x 6-ft. manholes, or, in a few cases, 6-ft. x 6-ft. x 8-ft. manholes. The combination trolley and illumination poles are placed from 105 to 115 ft. apart.

Galt's street illumination is one of the finest in Western Ontario, and much credit is due the officials who have had the installation in charge. Mr. R. Elliott is superintendent; Mr. Stuart Scott, manager, and Dr. Deakin chairman of the light and power commission. The standards used throughout are the well-known Luxolabra type.

Book Store Lighting

The photograph herewith, Fig. 1, represents the system of lighting recently installed in Tyrrell's new book store on King Street East, Toronto. The units are the Alexalite indirect, total reflecting type. These reflectors are made of

Fig. 1—Illumination of a Book store

steel and the reflecting surface is glass enamel. The outside surface is also glass enamel but is finished with a dead white finish which makes the fitting highly hygienic; it is claimed also that this finish will not deteriorate in any way,

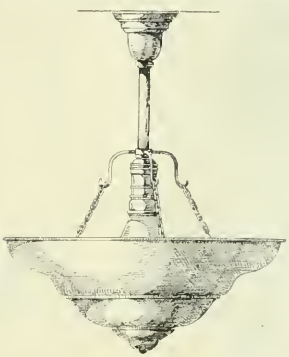


Fig. 2

that mechanical injury is practically impossible and that it can be cleaned without trouble. In certain cases a clear glass cover is supplied to keep dust from collecting in the interior surface and on the lamps.

A typical unit is shown in detail in Fig. 2. The reflector is seen suspended by three short chains, which, however, are not, in general, visible to the observer. The best results are obtained with these units by spacing them about 22 feet apart and well up, but in the Tyrrell book-store, where a specially high illumination was required, the units have been spaced 16 foot centres. Each unit is supplied in this case with one 150 watt tungsten with the result that they have a very even illumination with very high values at every point of the store.

Proper Lighting as a Factor in Accident Prevention

The importance of proper illumination for all work places cannot be overestimated from the point of view of safety. Those who have studied the subject are well aware of the considerable number of accidents resulting annually from defective lighting. Insufficient illumination is frequently held by juries to be "contributory negligence" in accident suits. In defence, the attorneys of one large manufacturing company I have in mind, find it a good plan to offer testimony proving the plant lighting to be sufficient and adequate.

Dangerous machinery should always be well-lighted. It is not of much use to place a guard upon a dangerous machine if the light is so poor that every moving part cannot be distinguished. Many a machine or process that might be considered safe in a well-lighted room becomes extremely dangerous if operated or performed in semi-darkness.

In foundries the insufficient lighting of passages often causes men to stumble over imperfections in the floor; in the case of a worker carrying a ladle of molten metal, a misstep may result in a serious accident.

Good illumination in mines, as elsewhere, is one of the most effective safeguards against accidents. Recent concern has been caused by the spread among miners of a nervous affection of the eye known as nystagmus, which celebrated physicians claim is due largely to the defective lighting of mines.

The cost of accidents throughout iron and steel plants can be directly or indirectly charged to inadequate lighting. The work is fairly hazardous and many of the workers are of foreign birth, unable to read or understand the written or spoken cautions for their safety. An iron and steel plant demands good illumination over a great range, varying from the executive offices to the yards; and where a plant is operated both day and night with a view to doubling its output, it is very necessary that the working conditions at night approximate those of the day. A recent extended study has shown that upon the proper solution of plant lighting problems depends, to a large extent, the amount and cost of production.

Proper lighting in factories not only benefits the employees but the employers as well, who find their insurance rates lessened by a diminished accident risk. The initial expense of installing proper lighting arrangements is very soon offset by the gain in the quality and quantity of the product.

It should be borne in mind that not only sufficient and well diffused light should be provided in factories, but that the lamps should be shaded from the eye and placed so that the direction of light is proper for mechanical operations. Many mishaps are undoubtedly due to the disregard of these principles.

A shop is completely demoralized by frequent accidents. The excitement and lack of security have the effect of making operators inefficient and nervous, while the work suffers. The economic advantage of accident prevention to the employer is therefore apparent, quite apart from the consideration of safety, freedom from strain, and greater efficiency of the worker. Considering proper illumination as a factor of safety, it is safe to say that the adequate lighting of shops and factories would probably prevent 25 per cent. of the avoidable accidents in industry.—Dr. W. H. Tolman in "Lighting Journal."

Influence of Proper Factory Lighting on Work and Workman

The influence of proper illumination both on the quality and quantity of work that can be turned out in a factory is now recognized as being very great. On other pages of this issue we describe in detail the illumination and wiring of a large Canadian factory where the value of proper surroundings for the workman is being already felt. We also print herewith extracts from a paper by Mr. W. Harrison in a current issue of the Electrical World. Mr. Harrison deals at length with the proper design of factory illumination.

"That good illumination in industrial plants is a factor in the cost of production is generally appreciated. It is the purpose of this article to discuss the requirements which must be met in the design of a satisfactory lighting system, to point out methods of design to be followed, and to show cost figures which will be of value to those contemplating the design of a practical lighting system.

There are four general requirements to be met—sufficient light of the proper quality on the work; a moderate intensity over the adjacent area and on the walls; absence of glare, and simplicity, reliability, ease of maintenance and low operating cost.

It is obvious that there must be sufficient light on the work. Better lighting facilities, along with practically all other improvements in industrial plants, are installed for the purpose of ultimately decreasing the unit of cost of production. From an economic standpoint, however, it is very difficult, if not impossible, to determine the proper intensity for a given class of work. This intensity depends upon the cost of producing light, the number and wages of the employees and the value of their output, as well as upon the nature and fineness of the work and the possible reduction in spoilage. Owing to the difficulties encountered in evaluating these quantities, estimates of the intensity of illumination required for any class of work have usually been based on other than economic considerations.

Considered only from the standpoint of safety to employees, 0.25 ft.-candle may, in most instances, be taken as the lower limit of permissible intensity in an industrial plant. The upper limit of needful intensity may be conservatively estimated at from 50 to 100 ft.-candles. Illumination of this order is sometimes required for operations involving fine detail, rapidly moving machinery and black surfaces, such, for example, as are common in the shoe industry. In this connection it must be borne in mind that after the apparent brightness of an object has reached a certain magnitude a further increase of intensity does not appreciably aid vision. The necessary volume of incident light will, of course, depend upon the coefficient of reflection of the object illuminated, but even for fine work on very dark goods intensities of the order of those stated above are considered satisfactory. Such intense illumination is usually required over but a limited area and, therefore, can best be supplied by the use of small lamps and reflectors placed close to the work.

While from 0.25 to 100 ft.-candles may be considered as the extreme range of intensity for artificial lighting in factories, the great majority of installations will fall within much narrower limits, between approximately 1 ft-candle and 6 ft.-candles. Many tables have been published designating the proper intensity of illumination for various classes of work, but this necessary intensity depends so largely upon the nature and distribution of the lighting units and upon local conditions as well as on the work to be performed that such tables should be used only with the greatest caution. Furthermore, as stated above, such estimates are at best merely on what is now considered good practice in plants where illumination tests have been conducted. There is no definite assurance that either a higher or lower intensity of light would not tend toward a more economical operation of the plant. As a matter of fact, the cost of adequate illumination for an industrial plant is so low in comparison with the value of the output dependent upon it that in many cases intensities considerably higher than those now supplied will be found profitable. At present an expenditure of 1 watt per square foot of floor area using an overhead system of tungsten-filament lamps and enameled steel reflectors is considered good practice for machine shops and other locations with similar lighting requirements. This will on the average correspond to an initial intensity somewhat in excess of 5 ft.-candles. Tables which give values of illumination recommended for various locations should be understood as merely an approximate guide.

To insure a satisfactory intensity of light on the work from a general overhead system of lighting, it is in most cases essential to provide light from several directions so that all sides of the objects viewed may be properly illuminated and so that if one lamp burns out, or the light from the unit be intercepted either by the operator's body or by parts of machinery, the resulting decrease in intensity will not be serious. In an installation of a few large units shadows are likely to be pronounced. Furthermore, there is a very decided decrease in the illumination when one lamp is extinguished and consequently the time of many workmen may be lost. A smaller unit will affect a smaller area and this area to a lesser degree.

Uniformity in Illumination

Again, with the lighting system in which a considerable number of units are used over an area, it is less difficult to produce uniform illumination. Where one class of work is performed in a given area, a uniform intensity of light over this area will obviously result in the most economical use of the total quantity of light supplied. With any of the artificial illuminants now available, it is impracticable even to approach uniformity of illumination where the distance between units is greater than twice their height above the work. One and one-half times this height is a more satisfactory ratio. For a given mounting height the allowable spacing of units is constant and independent of their candle-power. From the reasons outlined above it follows that an installation of a considerable number of units of low intensity will usually prove more satisfactory and, in the end, more economical than a system involving a small number of high candle-power illuminants.

A requirement of even greater importance than sufficient quantity of light of uniform intensity of illumination is that the intensity shall be constant. A flickering light produces the same effect rapidly repeated as is experienced when one passes from a dark room into bright sunshine. The efforts of the iris to accommodate the eye to the rapid changes of intensity produce muscular fatigue and nervous reaction which cause discomfort and pain.

In addition to supplying the proper light on the work, a well-designed system of illumination should provide for some light on adjacent objects and on the shafting and belting, as well as on the walls and ceiling. In many shops the intensity, except at a few points, is so low that it is scarcely possible to see one's way about. Such lighting is not only inadequate from the standpoint of safety, but also strains the eye. If the work only is brilliantly lighted and the rest of the room is in comparative darkness, the uneven intensity encountered by the eye in shifting from the work has a tiring effect not unlike that of a flickering light source.

From the psychological standpoint, bright walls and ceiling lend an air of cheerfulness and wide-awakeness to a room which is wanting where the work only is illuminated. If, as in a cotton or a paper mill, the materials are of such a color that they will reflect a large proportion of the light incident upon them, the resulting illumination received on the walls and ceiling will be sufficient to obviate any appearance

of gloom. If, on the other hand, the working surface is too dark to reflect much light in this manner, it may become advisable either to choose an illuminant which directs some of its light toward the ceiling and side walls, or else to provide a few lamps especially for this purpose. Such units would ordinarily be placed close to the ceiling in diffusing envelopes. If the walls and ceiling are necessarily dark, as in a foundry, it is, of course, useless to throw any light upon them. Keeping the walls and ceiling well whitewashed adds materially to the appearance of a shop as well as to the efficiency of the lighting installation.

Glare must be avoided. Glare is commonly defined as "light out of place." To cause glare, the disturbing element need not necessarily be a light unit. Glare may as well be the result of specular reflection from some brightly illuminated surface not far from the line of vision, or even from some polished portion of the work itself from which the image of the light source is reflected to the eye.

Recent investigations indicate that the extent to which vision is for the time impaired by glare depends primarily upon the total quantity of light received by the eye directly from the source, rather than upon intrinsic brilliancy; hence the distance between the eye and the source is of importance. If the source is of low intrinsic brilliancy—that is, if its candle-power per unit of erea is low—the effect of glare usually disappears very soon after the cause is removed. If, however, the source is one of high intrinsic brilliancy, such as the filament of a tungsten lamp or the crater of an arc, it may not only decrease the ability to see during its presence within the field of vision but will also tire or permanently injure the eye. The seriousness of this latter effect depends largely on the distance between the eye and the light source and also upon the brightness of the background against which the source is viewed.

In order that a lighting system may not prove objectionable from the standpoint of glare, it should be designed with a view to the following requirements: First—No source of light of high intrinsic brilliancy should be so located that it can readily be seen, except at a considerable distance. In cases where it is impossible to screen the source entirely, the presence of a brightly lighted background, such as the surface of a reflector, will considerably diminish the harmful effect. Second—No considerable amount of light even from a well-diffused source should be allowed to enter the pupil of the eye directly when it is focused on the work. This usually requires that no light source, unless remote, be visible when the head is inclined toward the working surface. Third—It is desirable that the area within the field of vision be uniformly illuminated; at least, the brightness of any portion of this area should not be materially greater than that of the object under observation. Fourth—Specular reflection should be guarded against so far as possible. Where the position of objects worked upon is fixed and the greater portion of the work is in one plane, lamps can be so placed as to avoid specular reflection in the direction of the eye. In the majority of operations in industrial plants, however, such conditions do not exist, and one should direct his efforts toward producing conditions which will allow the operator readily to shift his position in such a manner that direct reflection cannot reach his eye."

The Valleyfield Power Company is applying for an extension of charter powers to enable it to build an electric railway line from Valleyfield southwesterly through Beauharnois and Huntingdon counties to the provincial boundary; another line from the same place southeasterly through Beauharnois, Chateauguay and Huntingdon counties to the provincial boundary; and another line from the same place northwesterly across the St. Lawrence and the counties of Soulanges and Vaudreuil to the Lake of Two Mountains.

Maritime Notes

Tignish, P.E.I.

An electric plant consisting of a gasoline engine generator and storage battery is being installed here.

Buctouche, N.B.

Mr. J. D. Irving is installing an electric light plant to light his residence and mill. The generator will be operated by a gasoline engine. A storage battery will be installed, low voltage lamps being used.

Digby, N.S.

The Public Utilities Commission have been meeting here recently investigating complaints made by some citizens regarding services supplied by the Digby Electric Company. No decision has yet been given.

Bedford, N.S.

The Sackville River Power Company are installing a steam auxiliary at their hydro-electric plant. This company furnish light for the town of Bedford and also power for the manufacturing plant of J. A. Dunn, Limited.

Moncton, N.B.

Contracts have been awarded the Union Switch & Signal Company for the installation of an automatic block signal system. Three sections of track with a total mileage of 43 will be equipped. The contract price is in the vicinity of $85,000.

Yarmouth, N.S.

The corporation of Yarmouth are installing a motor-driven single stage turbine pump of 700 gal. capacity. This pump will be operated from the power lines of Yarmouth Light & Power Company, who have a ten-year contract covering pumping and lighting for the town.

Halifax, N.S.

The Halifax Electric Tramway Company are putting in considerable additions to their railway generating plant and have awarded a contract to the Canadian General Electric Company for one 500 kw. synchronous motor generator set; also for the complete reconstruction of their direct current switchboard.

Sydney, N.S.

The Cape Breton Electric Company are installing a 400 kw. motor generator set in their Sydney power house. The outfit will be used for operating cars in Sydney. The Canadian General Electric Company are supplying the equipment. A duplicate set is being installed in the reserve junction substation.

Summerside, P.E.I.

The Summerside Electric Company have recently put in operation a new gas engine equipment. The engine is a two cylinder horizontal type of 175 B.h.p. The producer is a 200 h.p. open hearth type. Both engine and producer were manufactured by the Crossley Gas Engine Company. The engine is belted to a 120 kw. C. G. E. 1100 volt generator.

Goldenville, N.S.

The Goldenville Mining Company are now operating their crushing and pumping equipment with electric motors, a hydro electric plant having been installed. The generators are 200 kv.a. capacity each and operate at 2200 volts, 3-phase, current being stepped up to 11,000 volts and transmitted seven miles to the mines, where it is transformed to 440 volts. The generators are of Westinghouse manufacture. The company have recently placed an order with the Canadian Allis-Chalmers Limited for a hoisting equipment consisting of a single drum hoist having a drum 41-in. x 28-in. with a rope speed of 450 feet per minute. This hoist is to be direct connected to a C. G. E. motor of 75 h.p., 3-phase, 60 cycle, 440 volts with necessary control equipment.

The Dealer and Contractor

The Wiring and Lighting of Canada's Largest Lithographing Establishment

A very complete electrical installation has just been placed in operation in the new Rolph & Clark lithographing factory on Carlaw Ave., Toronto. Incidentally it may be mentioned that this is the largest lithographing and engraving establishment in Canada and one of the largest on the continent. It is roughly calculated that the cost of the electrical installation with the machines involved, which does not include any generating equipment, will alone be in the neighborhood of $55,000. The building is constructed of steel, brick and concrete, with no wood, a condition which adds considerably to the difficulties of the electrical contractor.

The current is supplied by the Toronto hydro-electric system at 550 volts, 25-cycles, through underground conduit entering the factory immediately behind the switchboard. The 550 volt cables pass direct to a meter box which contains the meters, main switch and fuses, as well as current transformers. This meter box is fitted with metal sliding doors making it fool-proof as far as possible.

The current used throughout the factory is, for the most part, direct for motors, lighting, photography and electrolytic processes. For the necessary transformation a motor-generator set has been installed, Fig. 1, 150 h.p. capacity, which changes the 550 volt, 25-cycle current to 110 volts direct current. From the generator the cable leads are carried in conduit, under the cement floor to the main distributing switchboard. All distribution is in conduit. There are 40 main feeders leading out from the switchboard, carried in conduit varying in size from 2 in. to 4 in. diam., the feeders ranging from No. 4 cable to 900,000 c.m. cable. These are all carried down through the cement floor immediately behind the switchboard and distributed over the factory area. Condulets are used throughout wherever a turn is required.

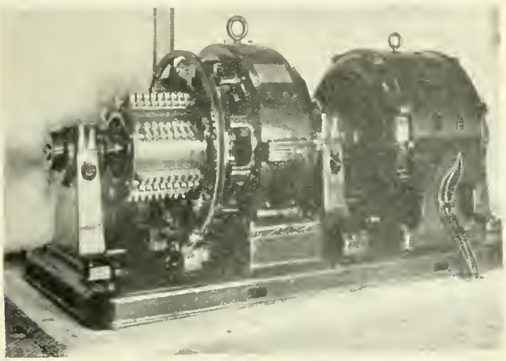


Fig. 1—Motor-generator set 550 a.c. to 110 d.c.

As a large portion of the energy is to be used for operating motors at different points throughout this large factory the conduit pipes were run out from the switchboard to the approximate location of these machines, this being done before any concrete was poured. When it had been definitely decided just where any particular motor would be placed, a hole was drilled through the concrete floor and the conduit extended to that point and up through the floor to the motor. There is no basement under the greater part of the building but sufficient space was left under the floor for the workmen to make the necessary connections.

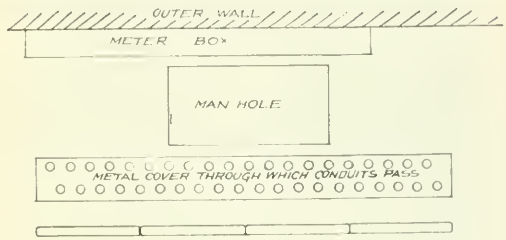


Fig. 2

The conduits which carry the lighting wires are run under the floor in the same way and brought up along the walls to panel boxes placed at different points.

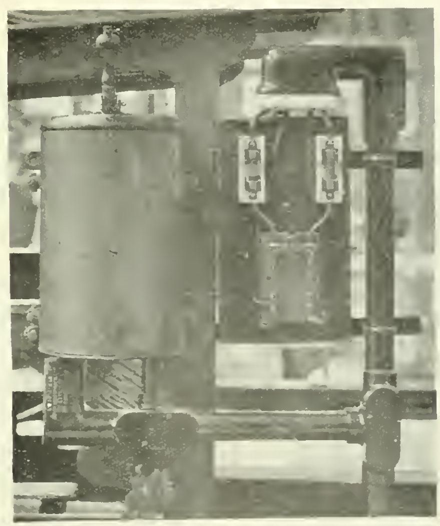


Fig. 3—Typical motor installation

The arrangement at the back of the switchboard where the conduits pass down through the floor is novel and par-

ticularly worthy of mention. Each conduit terminates in a coupling which is carried six inches above the floor level, with a condulet bushing. Instead of the usual open space when conduits are brought up through the floor, the opening has been covered with a metal plate about 9 ft. long by 12 inches wide by ¼ in. thick, which sets in the floor flush with the surface and has been drilled with holes to accommodate the 40 odd conduits used for the different circuits. This

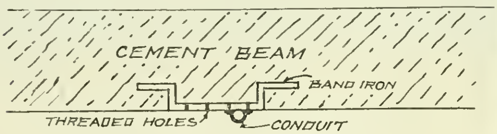


Fig. 4—Conduit under cement beams.

makes the installation dust and vermin proof, ensures good earth contacts throughout and adds greatly to the neat appearance of the power room.

Another feature which is simple in itself, but which helps considerably in expediting the work of making changes behind the switchboard, is a good sized manhole covered over with a hinged metal door. This manhole is of such a depth that workmen can stand in it and make splices or changes on the back of the switchboard in comfort. The diagram herewith ,Fig. 2, indicates the relative location of the switchboard, the conduit plate described above, the meter box and the manhole.

As an extra precaution, two 3-phase, 25 cycles, 20 kw. each, lighting transformers, 550/110 volts, have been installed. These are placed under the floor where they are out of the way and cool. They may be used for lighting either (1) in case of trouble in the motor generator set, or (2) if the latter becomes over-loaded, or (3) when it is not necessary to use the motor-generator for power purposes.

The switchboard is of marble and contains four panels equipped with the usual instruments, switches and circuit breakers.

The power room is entirely enclosed on two sides by

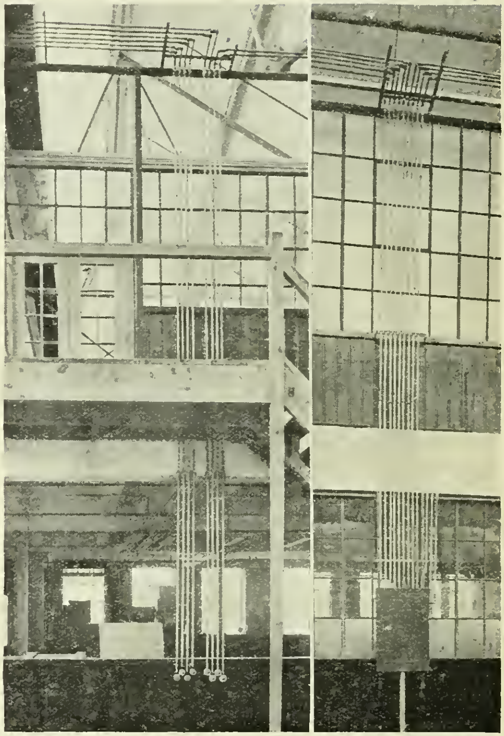


Fig. 5 Fig. 6

Figs. 5 and 6—Typical views of wiring—Conduit and condulets are used throughout the building.

Fig. 7—Main section of factory. 150 watt units placed 15 foot centres, 16 feet from floor.

glass, set in iron frames. This room is laid out in such a manner that the capacity can be doubled without any additional expense beyond the cost of the equipment.

The Motors

In all there are some 65 motors ranging in size from 3 to 10 horse-power. Very great care has been taken in connecting up these machines, having in mind their operation by entirely inexperienced and possibly careless workmen. The leading-in cables are enclosed in metal conduit right up to the controller and again from the controller to the motor, removing absolutely all danger to the operator. A typical installation is shown in one of the accompany photographs, Fig. 3, which indicates at the same time the safety factor and the standard of neatness observed throughout the entire installation.

The Illumination Conduits

For illumination of the various sections of the factory eleven cables, carried in conduit under the floor, feed the same number of panel boards placed at various points on the exterior walls. Each panel board accommodates from eight to sixteen circuits controlled by snap switches installed on the panels. From the panels outward all conduit is exposed, though, being installed with great care and neatness, it is very inconspicious.

As all interior structural work is either metal or concrete the method of attaching the conduit is of interest. When the forms were placed for the beams, and before any concrete was poured, the precaution was taken to place, in their proper position, strips of 3/8 inch x 1 inch band iron shaped as in Fig. 4. Four holes had previously been bored and threaded in each of the straps, as shown, so spaced that three pipe lines, if necessary, could be held side by side by pipe clips which, in turn, are held to the inset band iron by machine screws. Fig. 4 will give a general idea of the scheme, which has worked out very satisfactorily. The holes in the band iron were temporarily filled with putty to keep the concrete from setting in them.

In the main part of the factory, where the larger ma-

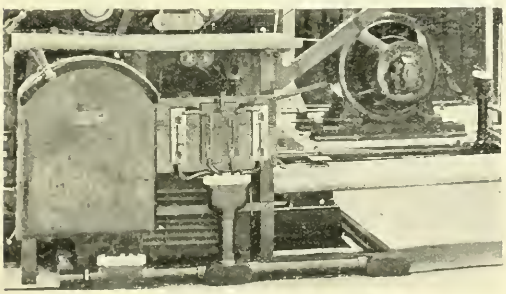


Fig. 8—Typical conduit leads to motors.

chines are placed, only the steel framework is available for carrying the conduits. In this case the steel frames were bored and the tubes connected to them securely by pipe clips and bolts. The outlet boxes are also bolted to the trusses. A typical view of the conduits distribution work is shown in Figs. 5 and 6.

The Lighting

As the factory will often operate at night special attention was given to illumination. Fig. 7 is a view of the main section of the factory before the machines were installed and shows the type of unit used and the plan of distribution adopted. One hundred and twenty-six 150 watt lamps, spaced 15 feet centres and 16 feet from the floor and backed by wide diffusing steel Holophane reflectors are suspended by bronze chains from the steel work. This gives an excellent distribution almost entirely devoid of shadows and illuminates every part of the various machines. This part of the factory includes the press room, finishing room, bronzing room and drying room. These lamps are all controlled by snap switches placed at convenient points.

The smaller departments of the factory are lighted, for the most part, by 100 watt lamps, with Moonstone shades, suspended from the ceiling by chains or tubing. In the transfer department and artists' rooms each man is supplied, in addi-

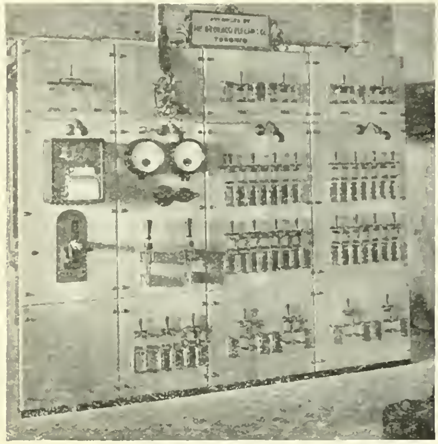


Fig. 9—Main Switchboard.

tion, with a drop light and a portable. In the main offices semi-indirect units are being installed. The photographers' room is fitted with arc lamps for photographing purposes as well as with general illumination.

The electrical equipment in the factory was supplied as follows:—motor-generator, switchboard, transformers and motors, Canadian Westinghouse Company; panel boards and condulets, Crouse-Hinds Company; conduits, Conduits Company; lamps, Sunbeam Lamp Company; reflectors, Holophane Company; arc lamps, MacBeth Company; motor-controllers, Cutler-Hammer, Carpenter type; cable and rubber covered wire, Imperial Wire and Cable Company; Sproat & Rolph were the architects for the building.

The entire electrical installation was planned and carried out by the O'Connor Electric Company under the direct supervision of Mr. F. E. O'Connor, president of the company.

Large Turbine Pump Order

The Abitibi Pulp and Paper Company have just placed an order for electrically driven turbine pumps with Canadian Allis-Chalmers Limited. It includes two high lift turbine pumps for ground wood stock, each 4,000 U. S. gals. per min. against 116 ft. head, 200 B.h.p.; two high lift turbine pumps for grinder pressure supply, each 450 U. S. gals. per min., 231 ft. head, 40 B.h.p.; and one high lift turbine pump for mill water supply 4,000 U. S. gals. per min., 173 ft., 250 B.h.p. There will also be two 14 in. centrifugal pumps for white water supply each 4,000 U. S. gals. per min., 35 ft. head and 75 B.h.p., and two 4 in. centrifugal pumps for slivers, each 500 U. S. gals. per min., 20 ft. head, and 8 B.h.p. All these pumps will be driven by Canadian General Electric motors.

It is understood that the plans of the Forest Hill Railway Company are practically completed and will be ready for submission to the York township council at an early date.

Sectional Book Case Idea Applied to Battery Charging Panels

Owing to the steady increase in the use of electric passenger and commercial vehicles, charging stations are called upon at frequent intervals to increase the capacity of the charging equipment. Because of this it is advantageous to install equipment to which additions can be made easily and economically. The new universal unit type charging panels made by the Cutler-Hammer Manufacturing Company are made up of self-contained rheostats assembled in frames in much the same way that the present day efficient sectional filing cabinets or book cases are assembled, each standard panel accommodating any number of sections up to six. Any number of panels can be assembled side by side according to the space available and, regardless of the fact that these may be installed at different times, will have the appearance of a complete equipment installed at one time.

Each Section a Complete Unit

Each charging section is a unit in itself as shown in Fig. 1. It consists of a slate front 24 inches by 10 inches, carrying the rheostat contacts and sliding brush; a low current circuit breaker, at left side; an instrument switch, at right; a pilot lamp and grid type resistance mounted on the back. Each section is supported by bolts to the frame, and after disconnecting from the bus-bar can be readily removed if these bolts are taken out. For repairs or inspection a section can be taken out about as easily as a drawer or section from a filing cabinet. On the upper left hand corner of the front a card holder is provided in which a card bearing the designation of the charging circuit can be inserted.

The low-current circuit-breaker mounted at the left of the front has a laminated brush main contact and auxiliary arcing points. It is interlocked with the rheostat so that it cannot be closed except when the sliding brush is moved to the position of "all resistance in." It can then be closed and a small magnet which is in series with the charging circuit holds it in this position unless the charging voltage falls to a value less than the battery voltage or in case the service fuses should be blown.

The instrument switch is a three-position switch having "open," "closed" and "reading" positions. When in the "open" position the circuit to the battery is broken; moving to the "closed" position completes this circuit, and when in the "reading" position the meter, which may be mounted on the top section or on a swinging bracket, is connected in the battery circuit indicating the voltage of the battery. If the low-current circuit-breaker is closed, the current is also indicated on the ammeter scale of the instrument.

Fig. 1—One of the complete units.

The duplex instrument which is furnished combines ammeter and volt-meter and a single instrument can be used for several panels, if desired. The scales are five inches long and thus allow very close readings.

The indicating pilot lamp is a four candle-power candelabra lamp connected directly across the battery leads, and is lighted whenever a battery is connected to the rheostat.

A discharge rheostat can be mounted on the top section to operate in conjunction with the charging rheostat section directly below it. A single pole double throw switch short circuits the discharge rheostat directly to the line. When closed to the right, the switch connects the discharge rheostat in series with the charging rheostat and connection is made so that with the instrument switch closed the battery will discharge.

As can be seen by referring to the illustration, Fig. 3, everything is within easy reach and no operating rods are required. The rheostat being arranged adjacent to the controlling switch eliminates the chance for error in operating the wrong rheostat. Meter readings are made without opening the charging circuit. The voltage and current may be read at any time by moving the corresponding instrument switch to the "reading" position. It is not intended that more than one of these switches be operated at one time but should anyone through ignorance move two at once, no damage will result, as by a special arrangement of the voltmeter connections, the cross currents resulting are made ineffective. When it is desired to stop the charge, the circuit is opened by moving the instrument switch to the "open" point, the arc formed on opening the circuit being taken on the auxiliary contacts which are provided with magnetic blow-out. This opening of the circuit de-energizes the low current circuit breaker which opens, disconnecting the battery from both sides of the line. When the plug is removed from the vehicle, the charging cable is entirely dead.

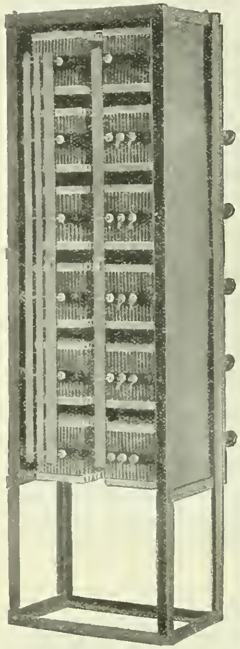


Fig. 2—Rear view.

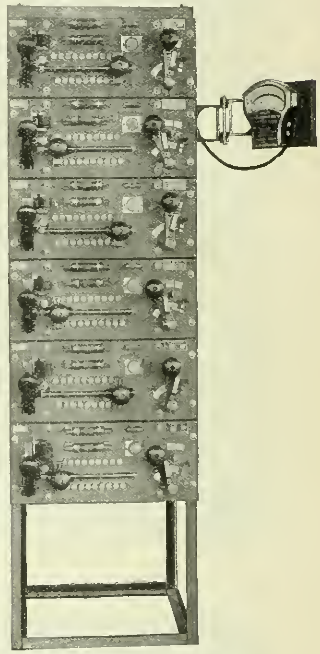


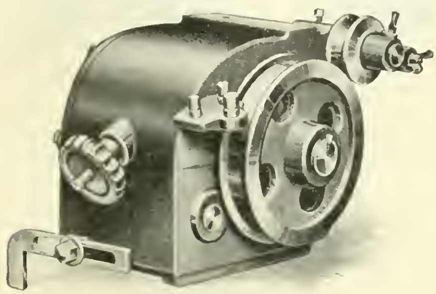
Fig. 3—Front view.

The rear view, Fig. 2, shows the simple connection arrangements and layout. As mentioned above the fact that the electric vehicle business is still in its infancy makes it particularly necessary that the charging equipment of the garages should be of such design as to allow additions to be made easily and economically. The sectional bookcase idea of standard unit type rheostats that can be assembled in any quantity seems to meet the requirements of not only the present but also the future.

Armature Band Wire Tension Machine

A new portable band wire tension machine of the Peerless type has recently been placed on the market by the Electric Service Supplies Company to meet the demand for a light portable device, which can be used to the best advantage in connection with an ordinary lathe and is claimed to be equally as efficient as any other method in use for rotating the armature. It is applied to a lathe by simply removing the tool post and inserting a bolt which clamps the machine to the cross slide.

This Peerless type affords a machine of the greatest precision from the fact that the tension can be regulated from the proper tension on the smallest band wire to the breaking strain on the heaviest used. By means of this adjustment the exact tension found suitable can be returned to at any time. This tension remains constant and uniform throughout the



Portable band wire tension machine.

banding operation without the slightest injury to the band wire or the generation of heat. Each pound applied to the brake drum is multiplied by means of gearing to 3 pounds at the band wire drum, which is tapered to compensate for the tendency of the wire to crowd up against the flange. On account of this gear reduction, a comparatively small braking effect produces a very great tension on the band wire, and any change in tension can be instantly secured by regulating the hand nut directly in front of the operator.

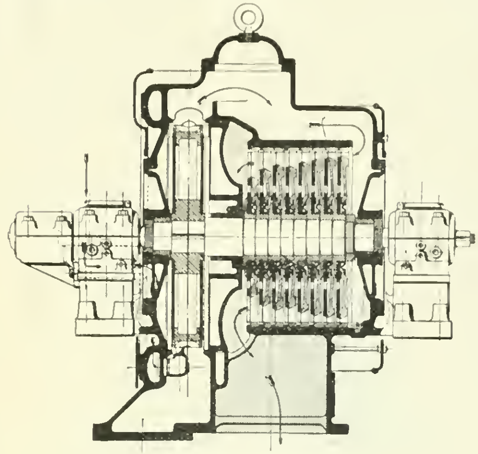
The Peerless portable band wire tension machine weighs 40 pounds complete, making it easy to handle and to adjust in a lathe. The gears, brake bearings, etc., are of ample strength, with large bearing surfaces, and are totally enclosed within the casing, which protects them and avoids possibility of injury to the operator. All bearings are readily lubricated from the outside by oil holes through the shaft.

New Type of Condensing Turbine

The illustration herewith illustrates a design of the latest type of Terry condensing turbine. The machine consists essentially of a multi-velocity wheel as the high-pressure element and a low-pressure end consisting of several multi-pressure impulse elements. The main feature distinguishing the arrangement of this low-pressure element from that used in other types, lies in the fact that it has been turned end for end, receiving steam at the end farthest from the high-pressure element and exhausting into the condenser connection at the centre of the turbine. By this simple device of reversing the flow of steam and thus protecting the vacuum gland, the old trouble of air leakage has been eliminated.

This turbine has the regular Terry characteristics, including casing split on the axial plane, permitting examination of the runner without disturbing steam or exhaust connections. It has the Terry indestructible high-pressure element which permits starting up the turbine from cold, even though a large quantity of water is thus thrown through the blades. This is done regularly, without any danger from water hammer or any apprehension as to stripping of blades.

The stationary buckets in the low-pressure end are placed on annular rings, from which they may be removed in blocks as necessary. These rings are not fastened to the casing, but



Terry condensing turbine

are bolted together and remain with the runner when the casing is removed. They are held by friction to the casing when the upper half is drawn down tight to the lower half and hence, always retain their position when the turbine is running. This arrangement makes it very simple to examine all parts with a minimum of trouble. This new design of turbine is being supplied to three principal uses:—Driving electric generators, blowers and centrifugal pumps.

Electric Light and Motor Wiring

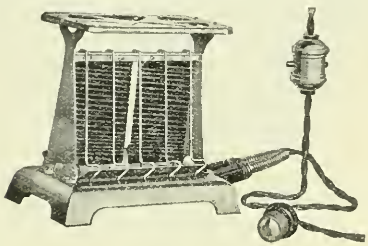
A new vest pocket book entitled "Electric Light and Motor Wiring," by Geo. J. Kirchgasser tells in plain English how the various systems of wiring are installed such as the open knob, moulding, metal moulding, knob and tube, flexible and rigid conduit and armored conductor systems. Over 150 illustrations and diagrams aid in making the descriptions clear. This book has several distinctive features. It does not simply develop the National Electrical Code but tells how the installations are made and what the restrictions are for light and motor equipments. Calculation of wire sizes, very complete motor and controller connections, tables, etc., are included in the 270 pages of this book. The small size of this book, only 2¾ in. wide makes it possible to carry it at all times. Another feature is that no advertising was solicited or accepted; the author is a firm believer in advertising but does not consider a text book a good advertising medium. For the electrical worker, contractor, electrical engineer, steam engineer, architect, central station man, student, etc., this book should be of considerable value. The Electroforce Publishing Company, Stroh Building, Milwaukee, are the publishers; price $1.00.

The Burrows Falls Power Company, of Ayer's Cliff, P.Q., has been acquired by the Sherbrooke Railway and Power Company, thus securing the franchise for the supply of commercial and municipal lighting and power in the town. The Sherbrooke Company controls the Eastern Townships Electric, Stanstead Electric, Lennoxville Light and Power, and the International Electric Light Company. The whole system is now connected by a main transmission line of over 35 miles in length.

Vertical Electric Toaster

The rapidly increasing popularity of electrical devices for cooking has resulted in the introduction of a number of economical devices for the table and in the home. One of the latest devices is the Westinghouse electric vertical toaster which has just been placed on the market by the Canadian Westinghouse Company. This little device, shown in the accompanying illustration, besides being beautiful in appearance is exceedingly economical in operation. The toaster is designed and finished for use on the dining room table; all parts are nickel plated and highly polished. It toasts two pieces of bread at once and has a place on the top where the toast may be kept hot.

This toaster has a record of 6,000 hours for toasting. This means it is capable of making eight pieces of toast every day for almost 100 years. The heating element is practically indestructible, being made of nichrome, a non-oxidizing and non-rusting alloy. The high efficiency of this little device is increased by a reflector at the base of the toaster which rests on an insulating asbestos board protecting the base from direct heat radiation or conduction. This construction enables the toaster to be used on an uncovered table without fear of damaging the finish of the wood. It can be used, therefore, wherever there is an electric light fixture.

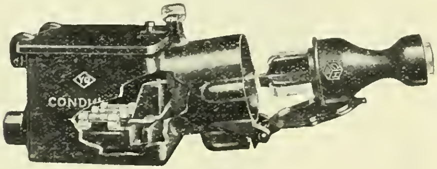


A new toaster

The toaster weighs slightly less than 2½ pounds and is seven inches in height. The current consumption is 550 watts at 110 volts, and two pieces of toast can be made thereon in less than three minutes. The toaster is furnished complete, nickel plated, with a silk cord and attachment plug.

A New Type of Condulet

A new type of condulet has been placed on the market by the Crouse-Hinds Company of Canada. This type is known as the "YQ," and is designed to provide a housing for the combination of plug receptacle and cut-out. They are particularly well suited for use in shops having portable tools, garages, laundries, railroad yards, etc. They are waterproof, and can therefore be installed out of doors. The cut herewith is a broken-away view showing cut-out PE3E and RYQ303 mounted, also plug RQ303 and padlock.

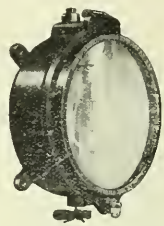


Type YQ condulet

Two types of N. E. C. cut-outs are furnished—plug or cartridge. Plug type can be used on circuits up to 30 ampere, 125 volts. Cartridge type can be used on circuits up to 30 ampere, 250 volts. The door over the cut-out is provided with a spring catch and can be locked with a padlock if desired. The door covering the plug opening is kept closed by a plunger spring when the plug is not in place, thus preventing the entrance of dust, moisture and insects.

New Reflectors

The Crouse-Hinds Company of Canada, Limited, Toronto, Ont., have issued a bulletin devoted to reflectors for use in roundhouses, steel mills, etc. The bulletin also contains instructions as to how and where the reflectors should be mounted so as to give the maximum amount of light where needed. These reflectors are in two general styles. One, type RM, is not unlike an electric car headlight in apeparance, and the other, type RS, is bell-shaped. Both have cast-iron cases and are gasketed, to make them gas, dust and weather-proof. The two cuts herewith illustrate the new reflectors.



Type RM.

Type RS.

Jefferson Glass Extending Operations

The Jefferson Glass Company announce that they are making cut ball globes, electrics, ceiling bowls, and in fact cutting all glassware described in their Bulletin No. 2, at their Toronto factory. They are also putting a decoration on their Moonstone glassware, shown on pages 11, 12, 13, 14 and 15 of their Bulletin No. 1. The colors on this glass are verde green, bronze, old ivory, pink and blue. The "electrics" are decorated to match the dishes and are very beautiful in their tints. This company are also now doing hand decorating and acid etching.

Moving to Larger Quarters

Owing to the increase in their business and the demand for better facilities, the Ferranti Electric Company are moving their Winnipeg offices and warehouse, on December 1st, from 56 Albert Street to the Farmer's Advocate Building, corner of Notre Dame Ave. and Langside Street. A large showroom will be fitted up where samples of all types of meters, transformers, switchboards, instruments, etc., can be seen.

Distributing Samples

The Canada Metal Company are showing their faith in their own products by sending out sample tins of their new soldering paste. We are advised that they are distributing 5,000 packages of their 2 oz. tins as free samples and that this product is meeting with favor wherever it has been tested out.

Mr. H. W. Young, president Delta-Star Electric Company, Chicago, addressed the Illinois Northern Utilities Branch of the N. E. L. A., Dixon, Ill., at their meeting November 21st, the subject being "Selling Power from High Tension Lines," which was illustrated by some forty lantern slides showing many modern outdoor high tension installations.

The Toronto Railway Company have practically completed their extensions on Shuter and Louisa streets, which are expected to relieve the Yonge Street congestion considerably.

Canadian Independent Telephone Convention

The Canadian Independent Telephone Association held its eighth annual convention in the City Hall, Toronto, on Wednesday, November 12th. A number of resolutions were passed, the substance of which were as follows:—(1) that all independent telephone companies purchase their material from manufacturing and supply firms that have no connection with the Bell Telephone Company; (2) that powers at present vested in the Provincial Cabinet by the Ontario Telephone Act be transferred to the Ontario Railway and Municipal Board; (3) that the railway boards of Canada be requested not to approve contracts between independent companies and the Bell Telephone Company unless these contracts contain a clause for direct inter switching between the different independent companies; (4) that a penalty be imposed where agreements between the independent telephone system and the Bell Telephone Company are not first submitted to the Ontario railway board for approval.

Mr. G. W. Jones, of the Port Hope Telephone Company, was re-elected president, with Mr. Denholm, vice-president. The executive committee consists of Anson Groh, Preston; Ont.; P. R. Craven, Timiskaming Telephone Company, New Liskeard; F. S.Scott, Brussels Municipal System, Brussels; A. Hoover, Home Telephone Company Markham; C. B. Adams, Harrietsville Telephone Association, Harrietsville; D. R. Dawson, Mount Pleasant Telephone Company, Castleton; F. E. Webster, Noisy River Telephone Company, Creemore; M. A. Gee, Erie Telephone Company, Selkirk, Ont.; T. R. Mayberry, Ingersoll Telephone Company, Ingersoll; Auditors, D. R. Beeton, Markham, and G. G. Hoover, Selkirk. Mr. F. Dagger was re-appointed secretary-treasurer.

Calgary Power Company's Extensions

The Electrical News published in the October 15th issue a description of the Calgary Power Company's extensions in which it was stated that it was the intention of the company to erect two additional 55,000 volt transmission lines connecting the power house with Calgary. The paragraph in which this item appeared was not part of the article submitted by Mr. McLeish and was only made to appear so by a mistake of the compositor. We understand from the company that this item is incorrect and that two additional transmission lines are not contemplated.

Montreal Electrical Society

At the regular meeting of the Montreal Electrical Society, held on November 3, Mr. L. E. Hamilton, of the Northern Electric and Manufacturing Company, read a paper on Fire Alarms. Mr. Hamilton gave a brief history of electrical fire alarms, stating that Boston installed the first system in 1851. The invention of the Gamewell system was referred to, the present apparatus being the outcome of improvements made by many people. Mr. Hamilton gave details of installations suitable for a village and for a city of 75,000 inhabitants, and also minutely described the mechanism and working of various forms of the apparatus. The paper was illustrated by a number of slides, facilities for the photographs having been given by the Northern Electric Company.

New Books

The Electric Vehicle Hand-Book—By H. C. Cushing, Jr., and Frank W. Smith, published by H. C. Cushing, Jr., 53 Park Row, New York, N.Y. The object of this handbook is to set forth as clearly as possible the fundamental principles in the operation, care and maintenance of electric vehicles, their batteries, tires, motors, controllers, and accessories. The book is well illustrated and contains a fund of information that will be of the greatest assistance to any one connected in any way with the operation or maintenance of electric vehicles.

The Electric Vehicle Association of America have prepared two booklets:—"The story of the electric pleasure vehible" and "The story of the commercial vehicle," which are being used by this Association in their publicity campaign. These booklets deal with the electric vehicle from both a historical and a practical point of view. In each case actual operation figures are quoted indicating the life of the machines and the cost of operation and the cost of repairs with other interesting data.

It is the desire of the publicity committee of this association to interest central station companies, accessory manufacturers, etc., in ordering a quantity of these booklets from the association to use in their publicity work on behalf of the electric vehicles. On the first issue of the books the cost is 25 cents each, but this price will be reduced depending on the extent to which orders are received; the initial cost of course is higher as it necessarily must cover the expense of the art work, plates, etc. The committee wish to emphasize that these booklets will not be sold at a profit but at the actual cost to the Association.

The judicious use of these booklets by central station companies, manufacturers of accessories, etc., will be of great benefit to the cause of promoting the electric vehicles and will at the same time materially help the work of the Electric Vehicle Association.

Trade Publications

Search Light Projectors—Bulletin 4928A issued by the lighting department of the Canadian General Electric Company on search light projectors for commercial use.

Magnetic Handy Lamp.—A folder issued by R. E. T. Pringle, describing the AB magnetic handy lamp which sticks to any magnetic metal and is especially useful around motor cars.

Radial Switches.—A booklet issued by the Crouse-Hinds Company of Canada, Limited, describing radial switches manufactured by this company, including voltmeter, ammeter and ground detector types.

Condulets.—A folder of the Crouse-Hinds Company of Canada describing and illustrating a type of condulet for every open conduit requirement; also porcelain fittings for condulets, conduit boxes, etc., etc.

Electricity in Iron Foundries.—Bulletin number A4167, issued by the Canadian General Electric Company's power and mining department covering, with illustrations, the application of electricity in iron foundries.

Catenary Construction.—A bulletin has been issued by the Ohio Brass Company of Mansfield, Ohio, containing construction details of a number of prominent catenary roads. The booklet is artistically designed, well illustrated and contains a quantity of useful information.

Polyphase Motors.—Bulletin No. 160, issued by the Bell Electric Motor Company, describing their compensated type of polyphase motors. This motor has many new features, one of which is that no compensator or starting box is required. There are two windings on the armature, one known as the squirrel cage winding, of high resistance, and the other underneath this, also of high resistance, which is short circuited before the motor obtains full speed. By means of the two windings, it is claimed that an extremely high power-factor is obtained and also a very high efficiency.

Current News and Notes

Amherstburg, Ont.

The Essex County Light Company are planning certain extensions to their electric light system.

Barrie, Ont.

The matter of an electric railway connecting Toronto, Barrie and Orillia has again been raised.

Battleford, Sask.

The town of Battleford recently contracted with North Battleford for a year's supply of electrical energy at the rate of 5c per kilowatt hour.

Bowness, Alta.

Tenders will be received up to December 31st by the Bowness Improvement Company for a 200 kw. traction motor, one 4 panel switchboard, one 250 kv.a. generator and a gas engine. Mr. T. L. Turnbull, 220 8th Avenue West, Calgary, is the engineer in charge.

Bowsman River, Man.

The Manitoba government telephone department have now reached this point with poles and wires. In a few days telephone connections will be given with Swan River, Kenville, Durban and Benito.

Brockville, Ont.

Tenders have been called for an electrically driven turbine pump for the water and light department.

Chilliwack, B.C.

At the annual meeting of the Chilliwack Telephone Company a dividend of $4\frac{1}{2}$ per cent. was declared, as compared with 8 and 10 per cent. in previous years. Larger expenditures in renewals and rest account additions are stated to be the main causes for the reduction.

College Bridge, N.B.

The power plant of the St. Joseph's College is being enlarged and remodelled. Two direct connected 125 volt direct current sets are being installed, also additional boilers, pumps, etc.

Davidson, Sask.

This town will install a small producer gas electric equipment for lighting purposes. The equipment will be supplied by the Canada Gas Producer Company, Barrie, Ont.

Edmonton, Alta.

In the neighborhood of $2,000,000 will be expended by the Alberta government on telephone extension work during 1914. This will include the erection of a large number of exchanges.

The University of Alberta situated in South Edmonton, will, in all probability, be installing an isolated plant in the course of the next twelve months. Data has already been collected.

Fredericton, N.B.

The installation of an electric light and power system in the city opera house is planned.

Grand Falls, N.B.

The town of Grand Falls recently completed the installation of an electric lighting distribution system. The energy is purchased from the Maine & New Brunswick Power Company, Aroostook Falls, N.B.

Grenfell, Sask.

On Monday, November 10th the electric light plant in the town of Grenfell was first placed in commission. The plant consists of a producer-gas electric equipment supplied by the British Canadian Engineering & Supply Company. Mr. George Parley is town electrician.

Guelph, Ont.

The annual report of the Guelph Street Railway Company (municipally owned) shows that gross receipts for the last 12 months were in the neighborhood of $50,000, leaving net profits of $16,000. The assets of the road are placed at $172,866. It is expected that two new cars and a quantity of wire will be purchased in the near future.

Hamilton, Ont.

The dispute which recently arose between the workmen and the G. M. Gest Company over the wage being paid on Hamilton underground electric work has been decided by the Hydro-electric Power Commission in favor of Mr. Gest. While the contract contains a proviso that current wages must be paid it is claimed that this condition is being adhered to.

Humboldt, Sask.

A by-law will be submitted asking authority to expend $20,500 on electric light and power extensions.

Kamsack, Man.

It is reported that the town council have leased the private electric plant of John Simmott and will extend the system to provide street lighting for a number of business houses and residences not now supplied. The town council recently passed a by-law authorizing the expenditure of $25,000 on a new plant, but the debentures have not yet been disposed of.

Lambeth, Ont.

The village council is considering the advisability of having Niagara power brought in for lighting purposes.

Le Pas, Man.

The wireless station at Le Pas point is reported completed. It will be placed in continuous operation as soon as the plant at Port Nelson has been installed. The electric plant for the town is also being put in and it is expected will be operated early in the new year.

London, Ont.

The London Street Railway Company have signified their willingness to give a Sunday service at the rate of seven tickets for 25c and maintain a schedule approximately half as frequent as on other days. This company put their first p.a.y.e. car into service about the middle of November.

Tenders are being called for a storage battery and charging equipment to be used in connection with a fire alarm system.

Megantic, Que.

Tenders are called to January 5th for the construction of a concrete dam in connection with a hydro-electric development for this town. Mr. E. A. Evans is engineer in charge.

Merrickville, Ont.

A delegation of prominent men from Merrickville, Ont., interviewed Hon. Dr. J. D. Reid, acting Minister of Public Works, on November 20th, and urged that the proposed im-

provements to the Rideau Canal be made in such a way so as to provide electric power for the town. Hon. Mr. Reid promised to consider the request very seriously.

Minnedosa, Ont.

The water supply of the hydro-electric plant here was recently interfered with by a beaver colony which had constructed a dam several feet high across a feeder running into Clear Lake from which the supply for the plant is drawn. The normal flow of water was restored when the beaver dam was destroyed.

Malakwa, B.C.

It is reported that a company will be formed here to install a local telephone system.

Medicine Hat, Alta.

The city council have decided to call for alternative tenders on a 1500 kw. and a 2000 kw. electric generating unit, though it is probable the contract will not be awarded for some time.

Moncton, N.B.

At a recent meeting of the city council a committee was appointed to look into the question of installing a plant at the pumping station to light the streets, city buildings and for all civil work.

Montreal, Que.

The Union Switch & Signal Company have been awarded a contract for the installation of an automatic signal system on the Intercolonial railway between St. John and Moncton, N.B.

Mr. Duncan McDonald acting for the Canadian Autobus Company states that their plans are progressing for placing a number of autocars on the streets of Montreal.

At the last meeting of the Montreal Electrical Society, Mr. L. R. McDonald, of X-Rays, Limited, gave an address on "High Frequency Electrical Currents and their physiological effects."

Mr. Walter Fowler has been elected president of the Electric Club of McGill University, in succession to Mr. Dawson, who has been compelled to retire from McGill owing to illness. At the same meeting Mr. W. McN. Forbes, consulting engineer, spoke on "The application of electrical engineering to mining."

After working night and day for over a fortnight, the Bell Telephone Company, Montreal, restored the Main service interrupted by the destruction by fire of the racks below the switchboard room. The occurrence involved 13,000 telephones, and to meet the emergency the company established about 500 public temporary connections. Although the fire was a comparatively small one, it involved a complete equipment of new cables comprising about 50,000 feet of various sizes, and their connection between the main and intermediate distributing frames. The fire is believed to have been caused by the wires coming in contact with a power wire, and the company are making a thorough investigation with a view to preventing a recurrence of the trouble.

The Canadian British Insulated Company, Limited, Montreal, have received an order from the Hydro-electric Power Commission of Ontario for 24,000 ft. of 300,000 c.m. three core paper insulated lead covered cable, for 13,000 volt service. This is a duplicate of the cable already connecting the Hydro electric Power Commission's step-up transformer station with the Ontario Power Company's power house at Niagara Falls.

New Glasgow, N.S.

The Pictou County Electric Company, as recently reported in these pages, are installing new generating equipment. We are advised that the Robb engine of 700 h.p. has arrived and will be installed immediately. The generator is being supplied by the Canadian General Electric Company. The Pictou County Electric Company have also on order two new passenger cars which are expected to be ready for delivery about January 1st.

North Bay, Ont.

Sudbury and North Bay have made a further request to the Hydro-electric Power Commission of Ontario for the development of water powers in their district.

Orillia, Ont.

At a recent meeting of the water, light and power commission it was decided to give a monthly rate of 20c net per sixty watt lamp for sign lighting.

Owen Sound, Ont.

It is understood that work will be commenced at an early date on the development of Eugenia Falls for supplying power to Owen Sound and the neighboring district. The total expenditure will probably run as high as $300,000.

Prescott, Ont.

An arrangement has been reached between the town and the Bell Telephone Company by which the town is permitted to use the poles of the telephone company along King Street for the purpose of stringing electric wires. The company makes a charge for this privilege of 75c per pole per year and the town will also be required to pay a portion of the maintenance charges.

Preston, Ont.

A by-law will be submitted to the ratepayers on December 15th for the expenditure of $18,000 on alterations and extensions to the electric light system.

Peterboro, Ont.

The plant of the Quaker Oats Company, Peterboro, has been equipped with an inter-communicating telephone system.

The Electric Power Company recently refused the city's offer of $95,000 for their distribution system in Peterborough. The city council have appointed Mr. R. A. Ross, of Montreal, as their arbitrator in the proceedings which will follow.

Point St. Charles, Que.

A contract for the supply and erection at the low level pumping station, Point St. Charles, of a 35 kw. direct current generator for electric lighting has been awarded by the city of Montreal to the Siemens Company of Canada, Limited.

Rainy River, Ont.

The Canadian Westinghouse Company have recently supplied Mr. W. H. Green, of Rainy River, with the following equipment:—two 50 kw. revolving-field, belt-driven generators, 3-phase, 2200 volts, 7200 alternations, complete with field rheostats; one 2 kw. 125 volt exciter, 1700 r.p.m.; one 4 panel black marine slate switchboard consisting of 2 generator panels. The four panels form one complete board with gas pipe frame to include one set of bus bars mounted on the top of the panel.

The E. Leonard & Sons recently supplied this plant with a 13-in. x 12-in. automatic engine which is a duplicate of one supplied by the same company in June, 1909. Steam for the two engines is supplied from two 72-in. x 16-ft. stationary return tubular boilers supplied by the same company. The E. Leonard & Sons also supplied one 26-in. pressure heater for use in connection with this plant.

Regina, Sask.

The suburban railway line, being financed by the Country

Club, is practically completed but the municipality of Sherwood through which it runs is very much opposed to its operation. It appears the consent of the municipality was not obtained before the work was done.

Tenders are called for automatic air-pressure force pumps, electrically operated, to regulate the water pressure at certain points in the city.

The operating returns of the municipal street railway system for the week ending November 8th are:—revenue, $4,289; passengers carried, 100,000; passengers carried, including transfers, 113,944. For week ending November 15th corresponding figures were $4,463; 109,767, and 125,034.

Red Deer, Alta.

At the annual meeting of the Western General Electric Company held here on November 19th it was decided to increase the capital to $500,000 so as to be in a position to meet the increased demand for light and power.

Rossland, B.C.

The Rossland Water & Light Company, Limited, recently decided to adopt the meter system of charging for electric lighting in preference to the flat rate now in vogue. The present rate of 50 cents per light per month will give place to a meter charge of 10 cents per kilowatt hour. The company announces its intention of allowing one year for the complete change of its system, work to be started immediately in the commercial section of the city, the residential districts following later. Following is the new scale of lighting rates proposed: Up to 100kw.h. monthly, 10 cents per kw.h; from 100 to 200 kw.h., 9 cents; 200 to 300 kw.h., 8 cents; 300 to 400 kw.h. 7 cents; 400 to 500 kw.h., 6 cents; 500 to 2,000 kw.h., 5 cents; 2,000 kw.h., 4 cents. In addition to the above, a meter rental of 25 cents per month will be charged for every meter up to a capacity of 20 amperes. Over 20 amperes capacity and up to 40 amperes, 50 cents per month per meter, with the usual government testing free.

Salmon Arm, B.C.

The new electric plant was placed in operation on November 6. DuCane, Dutcher and Company were engineers for the town.

Shoal Lake, Man.

An electric light by-law will be submitted to the ratepayers on January 1st.

Smith's Falls, Ont.

A new 275 kw. generator was recently placed in commission in the plant of the Smith's Falls Electric Power Company. This now brings the generating capacity of the company to over 1000 h.p., the machines being so arranged that they may be driven either by water power or by steam. Mr. Ross O'Hara is superintendent of the plant, and Mr. Geo. B. Frost, manager.

Saskatoon, Sask.

The city has awarded a contract to the Canadian Westinghouse Company for two electrically driven turbine pumps. The pumps will be of the De Laval type and the motors will be of the Westinghouse induction type.

Sherbrooke, Que.

The following is the Sherbrooke Failway & Power Company's statement of gross and net increases for the four months ending October 30th, 1913: gross increase, $7,805.62, 17.9 per cent.; operation increase, $3,519.11, 13.7 per cent.; net increase, $4,286.51, 24 per cent. The company have also entered into contracts for the sale of an additional 1500 h.p., which will come into force during the next three or four months.

South Vancouver, B.C.

The ratepayers of South Vancouver are giving hearty support to a petition which is being circulated throughout the district, asking the council to submit a by-law which will provide for the construction of a municipal electric lighting and power plant, preferably on the North Arm of the Fraser River, at a cost of approximately $300,000. While the council is at present averse to supplying any details in connection with the project it has been learned that the municipal electrical engineer Mr. L. F. Rawden has prepared plans for the installation of an extensive power plant, as well as for a complete system of distribution in anticipation of the proposed by-law being submitted to the property owners, and favorably voted upon, in the near future. The municipality will sell light and power for rates as low as is consistent with the initial outlay on the plant and its upkeep.

The municipal council have been advised by their engineer to consider the installation of a new system of street lighting.

St. Thomas, Ont.

The London & Lake Erie Transportation Company are planning extensions to their lines in a number of directions.

St. John, N.B.

On November 11th the street cars commenced running on Haymarket Square to Kane's Corner, at the Junction of the Loch Lomond and Russell Streets. The new loop around Russell Street is not yet completed, but work is being pushed forward.

Mr. H. M. Hopper, general manager of the St. John Street Railway, N.B., states that the car line will be extended to Crouchville before July 1st, 1914, and that the company is willing to extend to Little River as soon as the highway bridges are strengthened. These extensions are on the Courtenay Bay side of the city and in the vicinity of the extensive dry dock, wharves, etc., being built by the Government.

South Bolton, Que.

Mr. M. Houldsworth will require equipment necessary for a small steam electric plant which it is his intention to install in his mill.

Sudbury, Ont.

Two by-laws will be submitted on December 1st authorizing the expenditure of approximately $18,000 on the extension of the power house and pumping station and the electric lighting system. This money is to take care of extensions that have been already put in.

Swift Current, Sask.

A by-law will be submitted on November 22nd authorizing the expenditure of $15,000 for a fire alarm system.

Three Rivers, P.Q.

The city of Three Rivers have passed a by-law covering compulsory inspection of electrical work by the Canadian Fire Underwriters' Association, who recently opened an office in the city.

Toronto, Ont.

An isolated plant has just been completed in the Sick Children's Hospital on College Street, Toronto. Two units have already been installed of 100 kw. and 25 kw. capacity and have been running since the first week of November. The electrical equipment, including switchboard, was supplied by Messrs. Kilmer, Pullen & Burnham, Canadian agents for the General Electric Company of Sweden. The third unit of 75 kw. capacity has also been ordered and will be installed by the same company. The engines were supplied by Goldie & McCulloch, of Galt.

Further reductions in the price of electric current for

lighting and power uses is foreshadowed in the favorable reports being published by various cities and towns served with Niagara power. It is said that reductions ranging from 25 per cent. downward will be made.

The Ontario Railway and Municipal Board have provided a form of agreement which must be executed in future by the Bell Telephone Company and any other independent company operating in Canada with which they make connections. In the past it appears that the conditions have been more or less variable. By the new order of the board it is hoped that the contract form will be standardized in future.

Mr. R. C. Harris, Commossioner of Works, has recommended a number of new civic electric car lines. It is estimated that the total cost would be in the neighborhood of $1,000,000.

A report will be made on the number of hydro-electric lights required in the Moore Park district.

Mr. P. W. Ellis, chairman of the Toronto Hydro-electric Power Commission, has issued a report to the effect that the power and light departments have together sold 46,000,000 kw.h. during the first nine months of 1913, as compared with 23,000,000 during the same period of 1912, or just double the original amount. It is also pointed out that the cost has only increased from $133,000 to $177,000, an increase of about 40 per cent.

Vancouver, B.C.

It is reported that the Lillooet Light and Power Company will commence operations in the near future on the construction of a hydro-electric plant in the neighborhood of Lillooet.

Recent advices from the provincial forestry department state that the task of laying the government telephone cable between Shoal Bay on Thurlow Island and Heriot Bay, on Valdez Island is proving more of a problem than was at first anticipated; soundings taken along the proposed route indicating a far greater depth of water than previously reported. This cable is being laid in connection with the telephone line on Valdez Island, which communicates with the Dominion government telephone and telegraph line on the mainland, stretching from Vanconver to Lund, a distance of 100 miles. It establishes an important link in the general scheme of telephonic communication throughout the province, which has been planned for the protection of Crown timber from forest fires, and will provide direct communication between Thurlow Island and Victoria, as well as with Vancouver. The cable contains a single pair of wires and is heavily armoured to protect the conductors from damage by water. It is to be laid at a depth of approximately 1,000 feet for three miles, in three stretches, the first of these extending across Okisholo Channel, the second across Nodales Channel, and the third across Cordero Bay. It is believed this will be the deepest cable of any used for fire protection purposes in the world. The confined channels in the vicinity of Valdez Island compel the use of a small launch in the cable laying operations, the equipment on the vessel consisting of a donkey engine, by means of which, with the addition of improvised cable drums and winches, the cable will be paid out.

Victoria, B.C.

A committee has reported to the city council in favor of the erection, on down-town streets, of 15 street clock indicators.

Tenders have been called for the construction of a telephone line connecting the city with Sooke Lake, the source of the city's water supply, a distance of 25 miles.

Operations were suspended for a few days during the second week in November on a portion of the Vancouver Island Power Company's plant at Jordan River, Vancouver Island, following the washing away of the grade along which the flume line runs. The work of repairing the damage was hurried forward with the greatest possible despatch, the construction of a trestle being found necessary at the point where the break in the flume occurred.

During the temporary interruption of the service the company's auxiliary steam plant at Brentwood Bay, as well as the steam plant in Victoria was placed in commission and succeeded in supplying all the necessary power thoroughout the city and the district adjoining.

Verdun, Que.

The Verdun, P.Q., council are asking the Quebec Legislature for power to construct conduits for electric wires.

Watrous, Sask.

A by-law will be submitted asking the authority to expend $8,500 on an electric light plant.

Windsor, Ont.

At the January election a hydro-electric commission will be elected. The members of this commission will likely be paid a salary, the amount mentioned being $600 each.

The city council has recommended the extension of the street lighting system by some 200 lamps.

Winnipeg, Man.

The Central Canada Railway Company will apply for a Dominion charter to construct a railway from Edmonton to Winnipeg, taking in Yorkton, Saskatoon, Battleford and other points along the line.

The city of Winnipeg has awarded contracts as follows:—three 600 kw. transformers to the Canadian General Electric Company; electrolytic lightning arresters, the Canadian General Electric Company; switches to Ferranti, Limited.

Tenders have been received by the Board of Control for a 500 kw. motor-generator set.

An extension of the ornamental street lighting system is contemplated. It is likely that ornamental standards will be installed on both sides of Market Avenue.

The tender of the Suburban Rapid Transit Company, a subsidiary company of the Winnipeg Electric Railway Company, for the lighting of Portage avenue, west of the city limits, has been accepted by the municipality of Assiniboia. This tender calls for 60 arc lamps, not less than two thousand candle power each, at a cost of 20c per lamp per night. All necessary plant and equipment will be installed and ready for occupation by December 18th, 1913.

At a recent meeting of the electrical section of the Winnipeg branch of the Canadian Society of Civil Engineers Mr. C. E. Aldridge gave a demonstration on the pulmotor for resuscitating victims of electric shock.

On December 12th a vote will be taken covering a $1,000,000 expenditure on electric extensions.

Yarmouth, N.S.

The town council are considering the installation of a pumping unit. Power will likely be supplied by the Yarmouth Light & Power Company for its operation, and an alternative steam unit may also be put in.

New Companies

The Three Rivers Traction Company will apply for incorporation for the construction at an electric street railway in Three Rivers and the surrounding municipalities.

The Vaudreuil, P.Q., Electrical Company, Limited, has been incorporated with a capital of $50,000. The main object is to carry on the business of an electric light, heat and power company in all its branches.

Condensed Department

SECOND HAND ELECTRICAL MACHINERY

Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

GREGORY ELECTRIC CO.
CHICAGO, ILLINOIS
Established 1893

FOR SALE

Canadian Rights for an Electric Device which has been an immense success in the United States. Address Box 887, Electrical News, Toronto. 20tf.

Wanted Employees

Wanted—Electrical man with knowledge of gasoline engines, to sell and erect small isolated electric light installations. Good opportunity for young man. Reply giving age, experience and salary required to Box 916 Electrical News, Toronto. 23-24

ELECTRIC RUNABOUT

Advertiser buying larger electric car will accept $100 cash for 2 passenger Columbia with new exide battery.

Car in excellent running order—quiet and speedy. Will throw in extra motor and spare parts. Apply Box 914 Electrical News, Toronto.

TOWN OF YORKTON
SASKATCHEWAN

Tenders for Diesel Electric Machinery

Sealed tenders, marked "Tenders for Diesel Electric Machinery," addressed to T. F. Acheson, Secretary-Treasurer Town of Yorkton, Sask., will be received up to 12 o'clock, **Monday, December 22nd, 1913**, for the supply and delivery of one 500 B.h.p. combined unit. Specifications and all information may be obtained upon application to M. M. Inglis, Electrical Engineer, Yorkton.

The lowest tender not necessarily accepted and the right is reserved to reject any or all tenders.

T. F. ACHESON,
Secretary-Treasurer.

22-23

LIGHTING SCHEDULE FOR DECEMBER, 1913.

Courtesy of the National Carbon Company, Cleveland

Date.	Light.	Date.	Extinguish.	No. of Hours
Dec. 1	5 00	Dec. 2	6 20	13 20
2	5 00	3	6 20	13 20
3	5 00	4	6 20	13 20
5	10 40	6	6 30	7 50
6	11 40	7	6 30	6 50
8	0 40	8	6 30	5 50
9	1 40	9	6 30	4 50
10	2 50	10	6 30	3 40
11	3 50	11	6 30	2 40
12	No Light	12	No Light	
13	No Light	13	No Light	
14	No Light	14	No Light	
15	5 00	15	8 00	3 00
16	5 00	16	9 10	4 10
17	5 00	17	10 30	5 30
18	5 00	18	11 40	6 40
19	5 10	20	0 50	7 40
20	5 10	21	2 00	8 50
21	5 10	22	3 20	10 10
22	5 10	23	4 30	11 20
23	5 10	24	5 50	12 40
24	5 10	25	6 40	13 30
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28	5 10	29	6 40	13 30
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30	5 10	31	6 40	13 30
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Total Hours 249 40

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Generation, Transmission and Application of Electricity

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Wishing You A Merry Christmas

Nothing will add so much to the Christmas season's enjoyment as the feeling that Canada has passed the "peak" of the financial depression of the past few months. It is possibly too early to affirm this definitely but the opinions generally expressed by authorities in finance are almost invariably hopeful and in some cases most optimistic. We now appear to be standing on a solid foundation; the money strain is distinctly easing, building permits are showing good increases, banks are experiencing comparatively little difficulty in handling the crops, the more recent bond issues by our cities have met with good success and finally, the weak places seem to have all been exposed in the stock market, and there are encouraging signs that the savings of the past year are now being gradually brought into investment. This latter is a very encouraging sign and perhaps indicates, more than anything else can, the returning confidence of the public.

Prospects in the electrical trade are good. A large number of municipalities have been delayed in their extension work and may naturally be expected, with easier money, to branch out again in the spring. In the smaller lines in which the jobber or contractor is more directly interested the outlook is unusually encouraging, for the "small" man is probably better supplied with ready money than for many years, due to good wages and the atmosphere of thrift which has recently prevailed. The Electrical News believes Canadians never had better cause to give themselves up to the enjoyment of a Merry Christmas and this, we sincerely hope, one and all will be enabled to do.

Industrials Paying Bonuses

Mr. Frederic Nicholls, vice-president and general manager of the Canadian General Electric Company is quoted, in an interview, as denying the rumor that any material reduction in the working staff at Peterboro is contemplated. Mr. Nicholls states that, although the number of employees in Peterboro now approximates 5,000, there are so many departments in the Peterboro factories and the orders have been coming in so satisfactorily, he believes continued employment can be assured, in one department or another, to all. Mr. Nicholls attributes this desirable state of affairs—all the more remarkable in this time of semi-depression in many of our industries—to the splendid reputation of the products of his company, their diverse character, and to the fact of the tremendous expansion of Canada with the resultant expenditures for railway, public works, power and lighting supplies.

The Canadian General Electric Company is a splendid example of the Canadian industry which bases its operations on sound management and a faith in Canada's future. With such a foundation there does not seem to be any need to fear temporary storms like that of the past year. Most of our troubles—domestic, individual and otherwise—are creatures of a too vivid imagination. We see calamities impending that have no existence in fact. A little more faith in ourselves as a nation and a little more confidence in Canada's future is a good lesson for us all to take to heart at the present moment.

The directors of the C. G. E. Company have since given tangible proof of their own confidence by the declaration of a one per cent. bonus along with the regular dividend

Ancient vs. Modern Electric Installations

From a western town comes the complaint that electric wiring is many times more costly than it was a few years ago and a committee will investigate and report. It may be this municipality are being held up by electrical contractors who take this method of balancing their account against the inactivity in real estate; but it is far more probable they will only find the cases they compare are not parallel and that the requirements of electric installations of to-day as compared with a few years ago are so totally different as to make comparison of even similar costs a sheer waste of time.

Electric wiring of a few years ago consisted in the crudest workmanship imaginable, with equally crude and unsafe systems. The old open work with knob and cleat was not safe even when first installed, and it rapidly deteriorated. It was so simple to install wires that every member of the house from the shool boy up quickly became an electrician. The results have been highly unsatisfactory and often fatal, but always dangerous to such an extent that the public and contractor alike have clamoured for more stringent rules with greater safety to life and property. The Fire Underwriters' Association have also been keenly interested and have latterly framed a set of rules which, from their experience, are necessary to guard the interests of all.

Very possibly the public do not distinguish between electric wires wrongly installed and electric wires properly installed, which is tantamount to saying they do not distinguish between imminent danger and perfect safety. There is nothing more deadly than the electric current, but, properly controlled, it is the personification of utility and safety. This is the point, doubtless, the western town has missed but it is the all important one in every electric installation.

The modern methods of installing electric wires makes it a practical impossibility that harm should come to either life or property. Surely this is worth the extra cost. And even at that, the cost of installation as compared with its everyday usefulness is far less than with any other kind of equipment we purchase to assist us in our daily work or in

enjoying our spare moments. The expense incurred in a proper electric installation should more correctly be looked upon as an investment—it is permanent and it yields splendid dividends.

We do not wish to be understood as defending unnecessary or extortionate charges for this or any other kind of work but in as far as only necessary expenses are incurred there is no doubt that money spent on the proper installation of an electric system of any kind is well spent.

Is It Good Business?

The practice of financing the installation of new equipments by means of tender cheques, however satisfactory it may appear on the surface for the municipality concerned, is, we believe, impossible to defend from a business point of view. As this scheme appears to be an evolution of the fruitful western brain, it may be necessary to explain its operation, as it is not yet practised to any extent in Eastern Canada.

The town of Smithville, say, requires electrical equipment valued at $50,000 and calls for tenders. Along with the tenders, a guarantee of good faith to the amount of five per cent. is required, amounting in this case to $2,500 each. If twenty firms tender, the total amount received by the municipality in marked cheques is thus $50,000. If Smithville follows the practise of "cashing in" they now have sufficient funds to finance the whole proposition. It may appear at first sight that the relief is only temporary, but when we consider that, in some cases, months elapse before any decision is reached regarding the tenders, and sometimes more months before the unsuccessful tenderers can get their money back, it will be seen that a considerable financial advantage is gained by the municipality.

However, quite aside from the legal or moral aspect of the case, it looks to us as if the game were not worth the candle. In the first place, it has been suggested that a municipality is lowering its dignity in resorting to such a practice. In the second place, it is pretty certain that the manufacturers take all these little things into consideration in submitting their tenders, with the result that the advantages to the municipality are more apparent than real.

We incline to the opinion that a municipality stands to gain every time by giving the manufacturer or tenderer as little trouble as possible. To this end we believe the guarantee accompanying tenders may safely be done away with or certainly reduced to a minimum. The delay in returning cheques is also bad business and will be remembered by the tenderer the next time this municipality is in the market for equipment. A guarantee for fulfilment of contract is, of course, another matter, though in this respect, too, the bounds of wisdom seem to be often overstepped.

Rights of Company Recognized

An interesting controversy has been going on for some time in Truro, N.S., between the Chambers Electric Light Company and the town of Truro. The Chambers Company were originally given a monopoly of the private and municipal lighting of Truro, but recently the town took the matter to the legislature and through the claim that the franchise conditions were not being properly observed they obtained the right from the legislature to instal equipment to supply light for the streets and public buildings. They were not allowed, however, to compete in private house lighting. The legislature also granted to the town the right to use the Chambers poles for their distribution wires.

Following this order it appears that the company decided they would rather have their wires under the municipality's wires and, so, lowered them, compelling the municipality to go to the top of the pole. The municipality objected and applied for an injunction to stop the company from lowering their wires. The company on their part made a counter claim alleging that a recent by-law of the town, requiring the use of certain wire by the company, was illegal. Judge Ritchie has finally handed down a judgment which is more or less a compromise. The judgment states that the lowering of the wires seems unreasonable and must cease, but the company's contention that the town's by-law regarding the use of certain wire was illegal, is upheld. It is understood there is more trouble to follow and it looks as if the town might pay pretty dearly for their privilege of lighting the streets before the matter is settled.

Developments in Toronto's Purchase Problem

It is now definitely settled that the Toronto street railway "purchase" question will not be put to a vote on January 1. During the past few weeks the matter has absorbed the attention of a number of the more prominent business men with the result that many new phases have developed which will require much time for full consideration. One of the new developments is a counter proposition brought forward by the Board of Harbor Commissioners whose plan calls for the entrance of municipal radials from east and west along the water front with a subway running north and south to let north end radials in. It is claimed that by this plan the city outskirts would become more or less independent of the Toronto Railway Company, which could thus be left to live out its natural life of another eight years. The new plan is claimed to be not an alternative to buying out the Toronto Street Railway, but to buying out at the present named price, which the average business man appears to think excessive. Mr. Bion J. Arnold, commenting on the new scheme, is reported to have said that it would work in well with the mayor's scheme of purchase. If this is so, then, since each system would practically be independent of the other it begins to look as if the Harbor Commission's plan is a fair solution of the transportation of Toronto's suburban population without the expenditure of some $12,000,000 for "intangible" assets.

The Situation in Windsor

An interesting fight seems to be on between the Detroit Edison Company and the Hydro-electric Power Commission of Ontario in the Windsor district. The commission is running a high voltage line from St. Thomas west to Windsor to supply that town and the surrounding towns and villages as well as the municipalities along the transmission line with power and light. The Detroit Edison Company are said to have purchased a number of electric plants in this district including those in Walkerville, Essex, Amherstburg, Harrow, Leamington, Kingsville, etc., and to be making extensions preparatory to competing actively with anything the Ontario Commission may do. They claim, it is said, to be able to sell power much more cheaply than the Commission can at such a great distance from its source of supply. The Detroit Edison manufacture by steam in Detroit, but have a very large and modern plant under efficient management and are thus able to produce power at very moderate rates. One difficulty in the way of the competition is that the consent of the Canadian Government has not been given to the Detroit Edison Company to import power into Canada. The Detroit Edison Company claim that a conspiracy has been formed to prevent them from doing business in Ontario and point to an interference, with the arrest, of a number of their men a few days ago who were erecting poles in Walkerville. Following this incident the town were granted an injunction temporarily restraining the company from continuing the work but Mr. Justice Latchford has since dissolved the injunction.

In the General Interest

An order has just been issued by the Dominion Railway Board requiring the Toronto Power Company to move back one of their poles a couple of feet, at their own expense, in order that the city of Toronto may proceed with certain work at present under way. The order is worthy of notice as establishing a sort of precedent in such cases, though corporation counsel Geary stated that this was not the city's point of view and that there was no intention of a "general onslaught on the company." The order was issued on the grounds that the removal of the pole was necessary to allow improvements needed for the benefits of the municipality. The question was raised as to the jurisdiction of the Railway Board in such matters but Chairman Drayton pointed out that this was fully covered by the Railway Act. The order is also interesting in that it indicates both the power and the inclination of the Railway Board to let nothing stand in the way of improvements clearly shown to be in the interests of the general public.

Extensions to Filtration Plant

Tenders are received by the Mayor and Board of Control of the city of Toronto up to January 20 for a complete mechanical filtration plant, boilers, steam turbo-generators, and all appurtenances necessary to the completed plant.

The electrical equipment calls for a steam turbo-generator set of 1200 kw. capacity, 2200 volts, 1500 r.p.m., to operate condensing, and to be so constructed that it will run in parallel with the hydro-electric system. An exciter of the necessary capacity is to be direct connected to the turbo-generator shaft.

The necessary switchboard panels and instruments for the control of the generator, motors and lighting are also required.

Three pumps of a capacity of 36,000,000 gallons each per 24 hours, to be operated by three-phase, 2200 volt, 25-cycle, 720 r.p.m. motors will be required; also two rotary air-blowers to be motor driven. If these latter motors are designed for operation on less than 2200 volts, transformers will also be required. Boiler equipment to the extent of four boilers, internally fired, and having not less than 2200 square feet of heating surface each, will be needed; also wire, switches, brackets, lamps, etc., for lighting the entire plant.

Sherbrooke Railway & Power Company

Our last issue announced that the Sherbrooke Railway & Power Company have just acquired the assets and undertakings, which include the poles, wires, franchises and distributing system of the Burroughs' Falls Power Company, Limited, of Ayers' Cliff, Que. This adds another electric lighting system to the ones already owned and controlled by the company, which are as follows:—The Lennoxville Light & Power Company, Limited, which controls the business in Lennoxville and Huntingdon; the Eastern Townships Electric Company, Limited, which controls the business in Eustis, Waterville, Compton, North Hatley and Capelton; the Stanstead Electric Company, Limited, which controls the business of Beebe Plain, Hatley, Massawippi, Libbytown and Ways Mills; and the International Electric Company which controls the lighting business of Derby Line, Beebe, Que., and Derby Centre, Vermont, U.S.A. These vompanies have small water powers of their own. It has, however, been the policy of the company so as to facilitate giving the best service possible, to connect all these various electric light companies by one transmission line from the company's main development on the Magog river in the city of Sherbooke. The transmission line which is a 22,000 volt line, is 35 miles in length and taps en route the electric light companies owned and controlled by the company. As a result the company has become the controlling factor in the electric lighting and power business in the thickly populated district lying between the city of Sherbrooke and the United States boundary.

Dynamo Room Rules

The following list of rules is framed and hangs in a conspicuous place in a power house in one of our western towns. It contains some useful hints for the loafer. It is all too common to find the power house a sort of evening rendezvous with the engineer an unwilling host, afraid of giving offence to his patrons by hinting that he has work to attend to. Aside from wasted time, too, few people realize the necessity for absolute cleanliness in an electric plant or the difficulties in maintaining this condition.

1. Walk right in, spit on the floor or in the dynamos; the electrician likes it; tobacco chewers specially welcome.

2. Take Electrician's chair; he will always be pleased to sit on the floor.

3. The Electrician often has magazines, please help yourselves; if you do not like them just let him know what you do like, he will always be pleased to purchase them for you.

4. If the Electrician should be reading a magazine or book you think you would like, just take it, he will not mind.

5. Help yourself to cigarettes, tobacco, etc.; matches will be found in the cupboard.

6. Be sure and drop cigarette ashes in the dynamos; it increases the efficiency of the generators.

7. The cupboard is usually unlocked during night time; please have a good look at the contents of same; there are many interesting things and the Electrician will be delighted to explain any of them to you.

8. Ink and all writing materials will be found on the bottom shelf of the cupboard; please help yourself, the desk is entirely at your disposal.

9. Please remember the Dynamo Room was built for your benefit; be sure and make as much use as possible of it; eat your suppers there; chew tobacco and spit all over the place; the Electrician will be delighted to clear up after you.

Fire Alarm Apparatus in New C.P.R. Station

The most up-to-date private fire alarm system in Canada will be installed in the new C. P. R. station at Vancouver. The system will be on the lines of the standard Gamewell Municipal system installed in most cities and towns in this country.

At different points in the station a Type K closed fire alarm box will be located. This box consists of a breakwheel driven by a train of gears, and as each box has a different numbered wheel the exact location of the alarm will be indicated. This box is practically the same as a regular street box, but on account of being inside the building it has no outer case or lightning arrester. An alarm is sounded by breaking the glass and pulling the hook. The signal from any operated box will sound four 10 in. electro-mechanical gongs of regulation pattern. One 6 in. gong will also be installed.

The battery power will consist of forty Edison-BSCO. cells, and two panels will regulate the flow of current. One panel will have voltmeter and ammeter and switches, with rheostat to keep current at one-tenth ampere and test switches. The other panel has a relay which will give a disarrangement signal should the battery become disconnected or the circuit interrupted at any point. The test panels, batteries, gongs, and boxes will all be converted in series and current will flow at all times. Should the current become interrupted at any point a signal will be given.

This system has many advantages over the open circuit

systems installed in many buildings, the chief one being that it is always under test. A regulation fire alarm box will be installed at the office and upon the receipt of a local alarm the city brigade can be called from this box if desired. The equipment is being manufactured by the Northern Electric & Manufacturing Company, Limited, of Montreal, under the specification of the engineers, Westinghouse, Church, Kerr & Company. The equipment is the same as is being installed in the new C. P. R. Hotel at Calgary, and represents the very highest type of apparatus for private systems.

Montreal Electrical Society

Mr. W. J. Camp, assistant manager of the C. P. R. telegraph department, on December 1 gave the members of the Montreal Electrical Society a "Telegraph Talk." He described the apparatus used in telegraphy and traced the development of the system from its invention in 1837. At first metallic circuits were used, but these were abandoned, as the earth return was found more satisfactory. Copper wire, too, was originally employed, but it was displaced by iron wire, which in its turn gave way to a certain extent to copper when the hard drawn process was invented. The C. P. R. have about fifty per cent. of copper wire on their lines. Recorders were common in the early days, but Mr. Camp said that he questioned whether any such instruments could be found on the American continent, it being proved that operators would work more accurately and rapidly by depending upon sound alone. Mr Camp then illustrated on a blackboard the various instruments by which duplex, diplex and quadruplex messages are sent, stating that by the latter system four messages could be transmitted simultaneously, two in each direction, while by the Rowland printing system eight messages, four each way, could be transmitted, this being the greatest number that could be sent. Automatic telegraphs were largely used in Great Britain, messages being sent up to 2,000 words a minute. There was one used on the C. P. R., but owing to the long distance the rate was about sixty words per minute. Mr. Camp described the Morcom printing telegraph system used on the C. P. R., particulars of which have appeared in the Electrical News. Girls could, he said, after six months' training, send sixty messages per hour by means of this system, while the ordinary highly efficient operator did not handle more than thirty messages. The speaker also referred to the use of automatic repeaters, and concluded by relating a number of humorous incidents of trouble on the lines and mistakes in messages.

Copper Production in Canada

The report for the calendar year 1912 of the production, export, import, etc., of copper in the different provinces of the Dominion has just been issued by the Department of Mines, Ottawa. The total production of copper in Canada in 1912 estimated on a basis of smelter recovery from ores treated was 77,832,127 pounds which at the average price of copper for the year in New York, 16.341 cents per pound, would be worth $12,718,548. Compiled on a similar basis, the copper production of 1911 was estimated at 55,648,011 pounds showing a large increase in production of 1912. The average New York price for copper in 1911 was 12.376 cents, the increase in price being 3.965 cents, or 32.0 per cent.

In the Province of British Columbia, the copper production is mainly derived from ores carrying a very low content of the metal. In the smelting of these ores the copper losses in the slag are quite considerable, reaching as high, in some cases, as 25 per cent. or more of the copper content of the ore. With ores of this character there is, therefore, a wide difference between the copper content of the ore shipped from the mine and the copper metal recovered by the smelters.

With the exception of a small output of copper sulphate at Trail, B.C., the copper production of Canada is practically all exported for refining. The exports of copper in ore, matte, regulus, etc., from Canada during the calendar year 1912 are reported by the Customs Department as 78,488,564 pounds, of which 73,176,744 pounds were exported to the United States, and 5,275,820 pounds to Great Britain. The exports in 1911 were recorded as 55,287,710 pounds, showing a large increase in 1912.

During the calendar year 1912 the total imports were valued at $7,047,356, and included crude and manufactured copper to the extent of 42,832,747 pounds, valued at $6,741,895, together with other copper manufactures valued at $305,461, of which the quantity is not stated. In detail, these imports comprise: copper (pigs, ingots, scrap, blocks, etc.), 7,634,539 pounds, valued at $823,374; copper in bars, rods, coils, etc., 29,520,400 pounds, valued at $4,665,791; copper in strips, sheets, or plates, 4,462,400 pounds, valued at $841,207; copper tubing, etc., 770,576 pounds, valued at $167,257; and copper wire, 444,832 pounds, valued at $101,748.

The production by provinces for the years 1910-11-12 is given in the table herewith.

Provinces	1910.		1911.		1912.	
	Lbs.	Value	Lbs.	Value	Lbs.	Value
		$		$		$
Quebec	877,347	111,757	2,436,190	301,503	3,282,210	526,346
Ontario	19,259,016	2,453,213	17,932,263	2,219,297	22,250,601	3,635,971
British Columbia.	35,270,006	4,492,693	35,279,558	4,366,198	50,526,656	8,256,561
Other districts*	286,000	36,431	‡	. . .	1,772,660	289,670
Total	55,692,369	7,094,094	55,648,011	6,886,998	77,832,127	12,718,548

* Includes Nova Scotia and Yukon. ‡ A shipment is reported from New Brunswick

Aluminium

No commercial ores of aluminium have as yet been found in Canada. Aluminium is, however, made in extensive works at Shawenegan Falls, Quebec, from bauxite ores imported from France, Germany, and the United States by the Northern Aluminum Company. A wire mill for the manufacture of aluminium wire and cables is also operated by the same firm.

During the twelve months ending December 31, 1912, the imports of alumina were 22,400,600 pounds, or 11,200 tons, while the exports of aluminium in ingots, bars, etc., during the same period, were 18,285,700 pounds, or 9,143 tons, besides manufactures of aluminium, valued at $10,898. The imported alumina was valued at 2 cents per pound, and the exported aluminium at 10.9 cents.

Amicable and Business-like

It is pleasing to note that the city of Chatham and the Chatham Gas Company are negotiating for the purchase of the latters plant in a most amicable and business-like manner. The city council, acting on the advice of the Ontario Hydro-electric Power Commission, have, we understand, offered the sum of $410,000 for the complete electric and gas equipment of the company, which has been accepted. While it is evident that the Commission have driven a most excellent bargain with the company, it is gratifying to note the absence of any inclination to take undue advantage of the private company. If this reasonable attitude had been assumed earlier in the history of the Ontario Hydro-electric movement there would have been less talk in financial circles of the evil effects of the Commission's operations. We trust this is a precedent of what may be expected under similar future conditions.

Electric Reduction of Iron Ores

Encouraging progress has been shown in the reduction of iron ores with the electric furnace by a recently incorporated firm known as the Moffat-Irving Electric Smelters, Limited, Toronto. No new chemical processes are involved in the production of the metal but the method of procedure differs from others in that the ore, the lime and the carbon are all introduced into the furnaces in a finely divided condition. Further, the furnace is of such a design that the ore and lime mixture falls a considerable distance through the heated carbon monoxide before reaching the reduction chamber proper. It is estimated that approximately 86 per cent. of the reduction takes place during this fall.

The general plan of the furnace is shown in the accompanying sketch which is self-explanatory. The crucible is built on a substantial base of concrete. Above this hard burnt red bricks are used and finally the main body is built up of silica brick. The hearth is of rammed magnesite.

The finely divided ore particles are fed into the upper portion of the furnace by a mechanical screw feed. The lime stone is also fed in at the same level, in the same way. The carbon, in a finely divided form, is fed in at the bottom of the stack as indicated. By this arrangement the ore and lime fall several feet through carbon monoxide gas at a temperature of something over 2,000 degrees F., which results, as already noted, in the reduction of over 80 per cent. of the ore. The carbon dioxide escapes at the top of the stack.

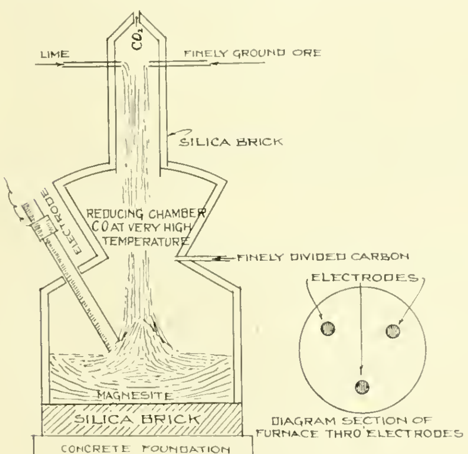


Diagram of Electric Reduction Furnace.

Three-phase current is used, the total capacity of the furnace being 300 kw. The normal voltage is in the neighborhood of 70, so that a current of about 2,500 amperes is used when the furnace is operating at full capacity. The power factor ranges around 90. This voltage can be varied, however, about 20 per cent. up or down, different voltages being found more suitable at different stages of the reduction.

Regulation of the electrodes is carried out by hand and practically no difficulty is experienced in keeping the three phases balanced. The electrodes are of graphite, 5⅛ inches in diameter. The ordinary threaded joint is used to secure a continuous feed of electrode into the furnace.

The claims made for the electric furnace are largely along the line of superior quality in the resulting steel. Its steel contains less nitrogen and especially less hydrogen than that of the open-hearth furnace where the molten metal is exposed to an oxidizing atmosphere. In the electric furnace a strongly de-oxidizing atmosphere exists. The conditions, too, in the latter furnace, permit of more thorough separation of suspended slag and the production of a metal much lower in phosphorus and sulphur.

The electric furnace at this plant operates on ore fines, —the troublesome waste product of blast furnaces—and is thus apparently destined to be a valuable auxiliary to the blast furnace.

The ultimate value of the steel being produced by this furnace can, of course, only be shown under test, though in outward appearance the castings as they come from the mould are so perfect as almost to resemble tooled steel. The appearance, however, is also borne out amply by the tests, a sample of which is given below. The content analyses were made by Kawin & Company and the physical tests by the Metallurgical Department of the Faculty of Applied Science of the University of Toronto.

An average of the last three heats made shows the following analysis:—silicon, 0.27; manganese, 0.70; carbon, 0.29; phosphorus, 0.31; sulphur, 0.31. The physical tests gave the following high average—elongation of 2-in. bar, 27.5 per cent.; elastic limit per square inch, 52,000 lbs.; ultimate tensile strength per square inch, 78,000 lbs.

At a recent meeting of the Moffat-Irving Steel Company permanent officers were appointed as follows:—J. B. O'Brian, K.C., president; James W. Moffat, vice-president and managing director; T. C. Irving, Jr., secretary and treasurer; John J. Gibson and W. H. Garvie, directors.

Loyalty in Business Life

Loyalty to the business organization of which one is a part is as necessary as faithful work. No amount of individual effort can offset a lack of co-operation. The stories of the business world's greatest success have been in a general way, the stories of harmony and team-work, which is equally as true in the electrical field as in any other department of business life.

The question of loyalty in business is discussed in the current issue of the General Electric Review by Mr. Chas. L. Clarke of the G. E. Consulting Engineering Department, and so many excellent suggestions are expressed there that we are reproducing herewith a number of extracts from Mr. Clarke's paper. If the treatment of the subject should appear somewhat disjointed the reader will please remember that these are extracts only and that such criticisms would not apply to the original paper.

"The general subject of loyalty in business life should always be of interest because it concerns certain relation between men that vitally affect their material interests. It is specially worthy of earnest consideration by the younger men, whose business careers still lie in the future, and whose habits of mind and dispositions have not become so firmly set that they should have much difficulty in subjecting themselves to a fair self-examination in the light of reason, and, if necessary, gain thereby with sensible exercise of will such control over adverse inclinations, when present as will naturally cause them to be loyal to their business associates on every occasion.

For the purpose of keeping consideration of the subject within reasonable bounds, that we may not become lost in the mazes of a philosophical dissertation, and fail to make such practical application of its leading principles as may be advantageous to ourselves, let it here be restricted to loyalty in duties required to carry on the affairs of a corporation, which are apportioned to employees in accordance with a sys-

tem of management organized for orderly and profitable conduct of business.

The loyalty, then, that should subsist in a corporation is:

First: Loyalty to the system of management, as organized, and not, necessarily, as one may think it should be, and would like to see it organized. The system is impersonal, and comprises a code of corporation business rules and regulations, sanctioned by law and effective thereunder. It is the guide-post which points the directions in which employees should go in the line of efficient duty; if not thus guided and obedient thereto they would soon become lost in confusion. The rules and regulations of a corporation are the underlying means by which duty is assigned and directed, and anything less than faithful effort to observe them is disloyalty to the whole business in hand and to every one whose welfare depends upon its success.

Second: Loyalty within the system to the persons in whom is vested the authority to manage the details pertaining to the assignment and direction of duties. Those in authority are absolutely dependent upon the loyalty of others under them for the business success of a corporation, and they could accomplish nothing without it no matter what their own ability might be. The higher the plane of authority on which they stand, the wider becomes the scope of the undertakings for which they are responsible; the greater are the trials they have to bear, and the severer is the tax on their patience, resourcefulness, common sense and endurance to keep even themselves in every way loyal to the trust imposed upon them under the system. Thus they need the loyal support of every one else to a special degree.

Third: Loyalty within the system between those whose authority or duties are practically co-extensive. Here there should be unreservedly faithful co-operation, absence of petty jealousy, undue self-seeking, over-reaching, bickering and backbiting, which interfere with efficiency and can prove serious forms of disloyalty, and are liable, even if the seed be sown by only one person, to produce much harm and with certainty prove the truth of Poor Richard's adage, that "A quarrelsome man has no good neighbors."

Fourth: Loyalty, irrespective of the system, between all employees of whatever grade, based upon mutual respect, general good will, pride in connection with the organization and with associates, and a sincere desire to help to the best of their ability to promote success.

It is not easy for every one, and, at times, not even for those most experienced and disciplined, always to be loyal to every duty. Sometimes its performance, as the saying is, "goes against the grain," in which case such adjustment to conditions should be made that "chips do not fly." At other times its performance may seem unnecessary, or the wrong way of getting at a desired result. And these are times when loyal patience is called for, patience to wait for time to tell one whether after all he may be mistaken, or to correct a method, if later found not the best one to pursue. While it is easy to be patient under accustomed circumstances, it becomes more difficult of exercise under trying conditions, when most required, in which connection it should be helpful to remember that Poor Richard said: "What signifies your patience if you can't find it when you want it."

Temperamental pecularities seem to make it practically impossible in some unfortunate instances for loyalty willingly to exist, the misfortune being mainly harmful to those thus afflicted, for they are either certain to be kept outside the pale of organized business, or to be bound hand-and-foot by limited duties and restricted authority so that they lose opportunity for achievement and advancement that might be theirs.

Then there are some whose characteristics only occasionally cause them to clash with the business system or with their co-workers, and become disloyal by not taking up and endeavoring to perform an allotted duty in line with the directions of their superiors. The effect is disturbing, so much so as to have a correcting influence on men of intelligence toward lessening or preventing repetition of the mistake. If they prove to be men in positions of authority, Poor Richard here advises them: "He that cannot obey cannot command."

Jealousy, which in its different manifestations may be given various names but smells no sweeter therefor, is, perhaps, the most frequent cause for lapses in loyalty. It is generally of the petty, evanescent sort, and fortunately, rarely manifests itself in the region of large responsibilities. Every one knows the cure, namely, get over it; toward the accomplishment of which end the realization that all must loyally work together, if the payroll is regularly to be met, should help.

Finally, there is the cranky man, who gets at odds with the system and with his associates on the most unlooked for occasions and for inexplicable reasons. His misfortune is inability to control impulse by exercise of will power, and he should make a special study of ways and means to cure the defect. Often he is mostly of good steel; the knife passes inspection and is placed in stock although the defects are recognized, but it will not, to his detriment, be rated A-1.

The stronger the effort made by all within the various departments of any great organization to constitute themselves a brotherhood of open-minded, open-hearted, mutually helpful men loyal to one another and especially so to their respective chiefs, the nearer will be the approach of the departments to ideal efficiency in performing the functions assigned to, and expected from them."

Rules Safeguarding Human Life

The Editor,

Electrical News:

It gives me pleasure to record a few of the impressions created in my mind during a first and very memorable journey across your vast and progressive continent.

In doing so, I desire to emphasize the fact that this letter is written, not in a critical spirit, but with the sole object of mutually ventilating a subject which is already foremost in the minds of many of your leading engineers.

In order, Sir, not to occupy too much of your valuable space, my remarks must necessarily be of a brief description, and I therefore purpose to restrict my comments as far as possible to a superficial comparison of the methods adopted by our respective countries in one particular direction.

I refer, Sir, to a comparison of the electrical rules and regulations as they exist and the method of enforcing them, having regard to the safe guarding of human life.

It will undoubtedly be conceded by every humanitarian that the progress of civilization must of necessity be retarded if the problem of the life hazard is in any particular direction seriously neglected.

It will also be conceded by every practical engineer that this same problem which makes for civilization must indissolubly identify itself with the rate of progress of electricity, in respect of its widespread and multitudinous industrial application.

With this assumption conceded, it appears obvious that it should be the premier object of the governing body of every community to provide rules and regulations in connection with the use of electricity to safeguard the public as far as is reasonably possible against preventable accidents and loss of life.

The governing body having made such regulations they must have the power to enforce them and to inflict penalties for non-compliance. It is here, sir, that I find the "Great

Divide"—it is here that the ways of the Dominion and the Old Country separate.

I am advised that there are no Rules and Regulations universally adopted throughout your country which have primarily been prepared with the sole object of taking care of the "life hazard." I am advised that with certain local exceptions the National Electric Code of the National Board of Fire Underwriters is generally adopted.

Now, I submit that while admitting the excellent pioneer service of this most respected and valuable institution, and passing over at the moment the admitted technical anomalies the Code contains, such an institution, by reason of its very constitution, cannot be a suitable governing body to regulate in its entirety, the problem of the life hazard.

The primary object of the underwriters must necessarily be and should be to protect the pockets of their shareholders against losses by fire.

Comparisons are oftentimes objectionable, but your country teaches us so many useful lessons that you can afford to believe that in this case the comparison is not an invidious one.

In the Old Country the method of procedure is different. Rules and regulations are issued by a governing body which has the power to enforce them. These rules are widely drawn to embrace the entire life hazard and are devised to protect "the man in the street" as well as the "employee" in the workshop.

They are entirely independent of any rules and regulations, which the fire underwriters are free to devise for their own protection against fire. Great care is exercised that no particular section of the industry is unduly hampered or fostered. The engineer is not the sole arbiter. Deliberate care is taken to avoid the recommendation of any special type or shape or measurement of apparatus, thus no embargo is placed upon invention. The degree of safety to be obtained rather than the method of obtaining it, is, and should be the object of the regulations.

Every student of thought in your country will agree that it is political suicide to adopt permanently a code which selects for universal use, certain dimensioned "types" or "makes" of apparatus. It is obvious that such a course is strangling the inventive faculty of the country at its birth and incidentally playing into the hands of the monopolist. It cannot be argued that the requirements of the National Electric Code are sufficient to prevent loss of life and accident, nor can a code be called consistent which presents in elaborate detail a specification stating that a 3 ampere 250 volt switch must have quick make and quick break and a suitable cover, and at the same time allow in the same factory a switch one hundred times larger, without either quick make or quick break and without any grounded or protective cover whatever.

Moreover, one is appalled by the number and frequency of accidents fatal and otherwise, which occur in the workshop and elsewhere. I refer only to those accidents brought to my personal notice during a brief stay in your country. All of these accidents were preventable and could not have occurred under the normal regulations obtaining in the Old Country. Moreover, I submit that it cannot reasonably be argued that the conditions of a new country demand a sacrifice of human life and limb on the grounds of mere "cheapness." This is false sophistry and not an acceptable theory to the rigid economist. I venture, in conclusion, to put just one case to illustrate the absolute danger of an attempt to standardize too rigidly any particular "speciality."

I submit for discussion that there are at least three important grounds for objection:—

(1) A Bad Electrical Practice on Technical Grounds.

(2) A Bad Business on Commercial Grounds.

(3) A Bad Fire Hazard on Both Grounds.

(1) Bad Electrical Practice on Technical Grounds

I refer you to page 136 of the 1913 edition of the National Electric Code and to the following statement—"with link fuse cutouts there is always the possibility of a larger fuse being put into the cutout than it was designed for, which is not true of enclosed fuse cutouts."

This statement being quite incorrect it is equally misleading. Wherever one goes, the private residence, the workshop, the theatre, the central station, nay even the underwriters' laboratories, one is overwhelmed with samples showing ingenious abuses of this "enclosed fuse which (the Code says) cannot be true." French nails, solid rods, brass tubes, zinc tubes, wires soldered across the old fuse case, wires twisted across the terminal contacts, and for the screw plug, the American penny, the wired cork and the more frequent "nick" with the pocket knife—and yet the Code still says—"It is not true that the enclosed fuse cutout admits the possibility of a larger fuse being put into it."

I submit, Sir, that it is never wise to commit to print a statement which cannot be established, and which the underwriters' engineers themselves do not attempt to defend. It can only serve to discredit in the minds of the uninitiated the other parts of the code regulations which are good.

It should be assumed as a basis of reasonable argument that at some time or other in the life of every pair of fuse terminals there will come a moment when through some reason or other there is no spare cartridge at hand. Numerous causes may account for this:—

(a) Demand exceeding supply

(b) Shipments lost or late in transit.

(c) Consumer omits to order spares, etc.

(d) Consumer realises that the condition of his electricity supply never warranted the introduction of the extravagant cartridge.

Obviously the consumer cannot allow his factory to stand still—he must try some temporary expedient, and invariably he does. It is here the Code fails conspicuously—it is here the risk of fire is increased, for not only is the length of air break too short to give reasonable protection, but the very nature of the terminals are the worst that could possibly be selected for the purpose.

The alternative method of course is to provide ample length of break and ample spacing for an open link fuse to break in air, and to provide a proper system of clamping for the fuse link, and finally to make it compulsory that every fuse, irrespective of its design must be enclosed in a suitable cabinet, so that under conditions of normal use or abuse there is no danger of the melted fuse coming in contact with any substance which might be ignited thereby (see Code page 136).

The judicious use of cartridge fuses, under these same terminals must be a question depending upon the conditions and pressure of the electricity supply. It must obviously be a question of education as between the supplier and the consumer. It is very significant when the electrical department of the city of New York consider it necessary to state in the latest edition of their electrical code (see page 157) "owing to the difficulty of making proper inspection of the fusing where fuses of the cartridge type are used, it is strongly recommended that this type be not employed where plug or link fuses may be installed."

(2) A Bad Business on Commercial Grounds

I am given to understand that the largest number of enclosed fuses are used on an alternating current voltage, not exceeding 110 volts. Everyone knows that an alternating current at this voltage presents little fusing difficulty, and to use a cartridge every time a fuse melts is very wasteful. Multiply this proposition by a million consumers and you have a national economical calamity. It is an undeniable fact that hundreds of thousands of dollars are wasted annually upon the

American continent by the wasteful use of cartridge fuses upon conditions of low voltage where their use is not warranted, and where an open link fuse in a suitable cabinet, would provide a lessened fire risk and a great saving in cost of renewals.

I do not wish to be misunderstood on this question. As a manufacturer I am an interested party and therefore biased in favour of the cartridge fuse, and I am fully alive to the necessity of its judicious use, particularly upon continuous current circuits. A properly designed cartridge fuse is the only fuse I know that can be relied upon to successfully negotiate a "dead short" under the most adverse conditions, but I say it with deliberation—the case for the cartridge fuse is, in my opinion, being prejudiced and its abuses encouraged by "indiscriminate recommendation." It is common knowledge that "over organization" can become an incubus; in like manner the ingenious plea of "interchangeability" can be so exaggerated that it becomes a fetish.

(3) A Bad Fire Hazard on Both Grounds

It is obvious from the wording that when the Code was first arranged it was either wrongfully or carelessly assumed that a form of cartridge and plug fuse had been invented which "could not be tampered with," and in consequence permission was given for such apparatus to be used without other external protection. Now that it is discovered that such fuses are recklessly abused, not only by the ignorant, but also by engineers themselves, the whole case for the use of the cartridge fuse without other protection fails.

If an N. E. C. standard fuse is tampered with and there is no external cover, the risk of fire through melted fuse metal coming in contact with any substance which might be ignited thereby (see Code page 136) is very great.

I submit, Sir, that here at least is a matter for the urgent and immediate attention of the National Board of Fire Underwriters. They have the advantage of possessing a distinguished staff, conspicuous for ability and for courtesy, and fully conscious of anomalies which exist in their Code and anxious to redress any just grievances.

It remains for the electrical trade and the public alike, irrespective of nationality, to assist them to make bold use of the pruning knife, to make the Code consistent and efficient, to model it so that according to the requirements it deals equally and fairly with the best accepted electrical practice, not of any one particular country but of every country irrespective of origin, and to fight courageously at all times the engineered opposition of the monopolist.

I am, Sir,
Your obedient Servant,
Herbert H. Berry,
Member Institution Electrical Engineers.
Member Engineering Standards Committee.
Member National Electrical & Allied Manufacturers' Association, Incorporated,
of Great Britain.

Conservation of Our Resources

Mr. P. W. Ellis, chairman of the Toronto Hydro-electric Power Commission recently delivered an address before the National Municipal League on the operation of the Toronto municipal plant, in which he outlined the history of the municipal movement in Ontario from its inception in 1900 to the present time. Mr. Ellis' remarks with reference to the necessity of this movement to offset the depleted areas of coal and the possible prohibition of exportation from the United Stated, are very valuable as pointing out to Canadians the necessity of conserving all their water powers for their own use. Mr. Ellis' remarks on this matter follow:—

"The question of motive power in the Province of Ontario is a vital one. With a population of about two and one-half millions, or one-third that of the whole Dominion, the value of its manufactured products in 1910, was estimated at $580,000,000, or as much as the manufactured products of the whole of the rest of Canada. In the maintenance and development of this vast and complex workshop, it is hard to overestimate the influence of cheap electric light and power. While the Province is enormously rich in agriculture, timber and certain minerals, it has no coal resources. Substantially the whole of the coal used in the Province comes from the Pennsylvania coal mines. There are coal deposits in Western Canada and in Eastern Canada, but the cost of transportation forbids their profitable use in this Province. In the year 1909 six and three-quarter million tons of bituminous coal having an entry value of $13,000,000, were imported into Canada, almost the whole of which represented Ontario imports from Pennsylvania mines, upon which the manufacturers of this Province paid a duty of upwards of $3,000,000.

With the growth of manufactures, which in Ontario is proceeding at an unparalleled rate (the output for 1910 being nearly 250 per cent. of that for 1900) there will be a corresponding increase in coal consumption or in that of an equivalent substitute. The coal beds of Pennsylvania, however, are being depleted, and there is no assurance that even while their supplies last they will be available for the use of the manufacturers of this Province.

In the absence of a competing substitute for coal being made generally available, it is inevitable that the price of Pennsylvania coal will steadily increase, while it is also possible that national necessities may, at some future date, lead the United States to prohibit the exportation of coal from the diminishing resources of Pennsylvania. The ultimate effect of either of these conditions upon the manufacturing interests in this Province would—if it were not neutralized by the development of our water power resources—amount to a most serious calamity.

For the ingenuity, the enterprise and the generosity of the great mass of the people of the United States, we in this Province have the most profound admiration, and if, under the necessities of unchangeable natural conditions, the coal supplies of Pennsylvania were by legislation denied to us, we could not quarrel with the policy of a friendly sovereign state, dictated by such conditions, while we might well be seriously alarmed by the magnitude of the consequent disaster.

Our manufacturing status and our competing power at home and abroad depend upon our ability to procure ample supplies of motive power and light on favorable competing terms. Either of the foregoing conditions, would, if not overcome by our Hydro-electric policy, place a permanent and increasingly heavy brake upon our manufacturing activities. We would require to bring coal in at abnormally high prices from the far East or the far West to the surrender of our present position of manufacturing pre-eminence and to the consequent destruction of much of our enormous capital investments with the further effect of seriously arresting our national development.

The conditions and possibilities thus briefly outlined will suffice to indicate the tremendous importance to us of procuring as best we can, adequate supplies, at the cheapest rates possible, of that motive power without which, our manufacturing supremacy in Canada and our manufacturing position in the markets of the world cannot be maintained."

The paper further dealt in brief detail with the physical aspects of the Toronto system, its cost and the rates charged. Regarding the setting aside of depreciation and sinking fund allowances, yearly, Mr. Ellis has this to say:—

"It is, perhaps, interesting and instructive to note that a commercial company always raises a large part, when not the whole, of the funds required to provide for construction ex-

penditure by means of perpetual share capital. As the moneys so raised do not require—apart, of course, from the liquidation or selling out—to be returned to the shareholders, it is not necessary in such cases to load the rates with any sinking fund designed to repay the capital. In the case, however, of a municipal undertaking, such as the present, the conditions are entirely different. The undertaking has no capital as such. It is built out of the proceeds of debentures which require to be paid off at maturity. Unless, therefore, the rates are loaded with an adequate sinking fund charge, the accumulation of which extinguishes the debt at maturity, it would require to be paid off at the expense of the ratepayers at large. It is sometimes suggested that to load the rates not only with an adequate allowance for the sinking fund obligations, but also with proper allowance for depreciation, is unfair and that such policy would impose such a burden upon any undertaking submitted to it that it would necessarily lead to disaster. It might be well to examine this question. It is a very simple one. Depreciation is a grim reality. No undertaking, whether commercial or municipal, can escape it. The world goes on improving its instruments and methods of production, rendering obsolete in consequence antecedent methods and instruments without regard to individual wishes. Wear and tear operate continuously upon all apparatus subjected to its influence, without regard to municipal resolutions or to doctrinaire theories. Unless, therefore, funds are accumulated out of rates, to make good the inroads of the two influences in question, they must be obtained from other sources. This means, in a municipal utility of this kind, that unless the rates are loaded to provide these funds, there must be continual applications to the ratepayers at large, for authority to issue further debentures from time to time for capital replacements, or in the alternative, they must confer a discretionary power upon the Council for such further issues as may be required.

I do not know of any course that is more likely to undermine public ownership sentiment than to adopt a policy under which the ratepayers are asked to sign in advance a blank cheque or to submit to constant applications for further grants in aid of capital replacements. It is a simple matter to go to the ratepayers for $10,000,000 to build an undertaking, and five years afterwards for $5,000,000 to enlarge the undertaking, upon the understanding that it will be conducted on absolutely self-supporting principles. When 30 per cent., 40 per cent. and 50 per cent. reductions, from existing light and power rates can be shown to follow the establishment of self-sustaining municipal plants, the ratepayers can usually be relied upon to sanction the necessary municipal debt, but if it should be explained to them that such undertakings shall not be made self-supporting and that in consequence the original debt which they are requested to authorize is to be followed at periodic intervals by further issues of debenture debt to replace depreciating physical assets, their fears of a needless expenditure may well be excited to the point of refusing it altogether.

In regard to the remaining question as to whether the imposition of the double burden of depreciation and sinking fund upon the rates may not prove intolerable, it is enough to say that those who indulge in such fears have given no adequate consideration to the matter. Our own experience—and it is not yet two years since we commenced operating in a real way—has taught us that the rates quoted above, which are greatly less than the pre-existing commercial rates, are amply sufficient upon a reasonable volume of business to bear the double load, and as business increases to accumulate surpluses which will be available either for the purpose of rate reductions or capital expenditure enlargements as may be deemed best."

The speaker stated that the results to date have been very satisfactory. At the beginning of November, 1913, they had approximately 22,122 complete services with a connected load of upwards of 75,000 h.p. 35,000 lamp units have been installed to date on the city streets. A surplus over all charges for the year 1913 of over $100,000 is expected.

Regarding the effect of competition Mr. Ellis adds:

"The competitive effect of the establishment of the civic plant has not been destructive as was freely predicted at the time of its inception by its commercial competitors. The fact of the matter is that the potentialities of the power and light business are so great that few companies enjoying a monopoly thereof are alive to their posibilities. The rates of the competing commercial company in this city have been reduced to meet our own. There has been a very great advance in the quality of the service given to the citizens and a very great increase in the activity and intelligence with which business is cultivated. The cheapening of the rates and the extension of the uses to which electricity is now put, is having the effect of greatly increasing its total sale in this city, and province."

Electrical Situation in Winnipeg

Mr. H. A. Robson, Public Utilities Commissioner of Manitoba, gave out a statement showing the financial position of the light and power department of the city of Winnipeg as at April 30th, 1913. As this is the first complete statement of operation of this system we are printing extracts of it below. The figures go to show that up to the date named the deficits aggregate $142,274.64 and the total expenditure was $6,623,665.56.

A statement is also handed out regarding the financial position of the Winnipeg Electric Railway System and two of its subsidiaries, namely, the Winnipeg, Selkirk & Lake Winnipeg and the Suburban Rapid Transit Company. The net revenue of the street railway department of the W. E. R. Co. for the year ending December 31, 1912, was $748,972.04; the net revenue from the electric light and power department was $373,677.26; the net revenue from the gas department was $71,813.82. This gives a total net revenue from these three sources of $1,194,463.12. After deducting common stock dividends of $720,000, there is a surplus for the year of $474,463.12. The total assets of the company are placed at $19,461,624.89.

The financial statement of the Winnipeg, Selkirk & Lake Winnipeg Railway shows that the net income from this subsidiary was $9,499. A net deficit was shown by the Suburban Rapid Transit Company of $43,469. No dividend was paid on the common stock of either of these subsidiaries.

Following is the statement of Commissioner Robson regarding the Winnipeg light and power system.

Winnipeg's Municipal Plant

The practical application of the accounting provisions of the Public Utilities act to utilities is being gradually attained. The three most prominent utilities are the Manitoba Government Telephones, the Winnipeg Light and Power Department and the Winnipeg Electric Railway Company.

The purposes of supervision of accounting in the case of utilities constructed out of public moneys is different to that where the concern is privately owned. In the latter case accounting to a commission shews what is being made out of a franchise. The effect on rates and betterment of service is also a feature. In government and municipal ventures the application of the public money is an additional element not present in private enterprises.

In June last accounts of the city light and power department were filed with the public utilities commission for the year ending 30th April, 1913. These accounts evidently

required expert consideration, and they were submitted by the commission to Mr. John Scott, C.A., for examination.

With slight exception the depreciation percentages proposed by the city's manager in respect of plant were adopted. Besides depreciation of physical assets, such items as interest during construction, and costs of financing, are to be amortized by distribution over proper periods.

Two important questions regarding depreciation came up. First as to the period at which the depreciation reserve account would be started. The plant commenced operation on the 1st November, 1911. It was thought expedient to give a year's time to get the business going without burdening the accounts with depreciation charges, so that in the revised balance sheet for the year ending 30th April, last, depreciation is charged for but six months, i.e., from the 1st November preceding. The depreciation for the six months was $99,662.32.

Yearly sinking fund payments to meet the debentures are less than the depreciation amounts. It was thought unjust to those of the present time, and unduly beneficial to the future, that both sinking fund and depreciation reserve should be set up so that it is provided that out of the depreciation reserve may be taken whatever sums are necessary to pay to the sinking fund trustees.

The reserve accounts include sinking fund items for a short period before the depreciation charge commenced, hence the difference between the depreciation charge and these reserves. The main sinking fund payments on the debentures were not required to commence until one year after the plant commenced operation. The commencement was 1st November, 1911, so that it is only from the 1st November, 1912, that the plant has been carrying its real financial load. Henceforth the plant will set aside depreciation out of which the sinking fund payments will be taken. It will not be required to provide both.

The examination conducted by Mr. Scott, the commission's accountant, was not pretended to be an exhaustive audit. Nevertheless a great deal of time was taken in eliciting information and in discussing with city representatives and officials the points which presented themselves on the surface. The revised balance sheet recently completed, and now published, is the result.

When the accounts of April 30 last were filed they were accompanied by a notation that they did not contain certain items to be charged when audited. These items were:

Accounts payable—

Capital	$74,918.53
Stores	39,825.39
Operating	11,501.20
Accrued interest on stock and debentures	34,559.69
Wages	7,653.85
Accounts receivable	70,444.43

These items are included in the accounts now furnished.

It is to be remarked concerning accounts payable that heretofore, whether because of haste in construction or otherwise, there has been a lack of record of the obligations of the department on current account. Uncertainty as to exact standing of accounts payable has resulted.

The accounts originally published showed an actual capital expenditure up to 30th April, 1913, of $5,759,169.09. The accounts now show expenditures $6,143,693.04 as of that date. The difference is made up as follows:

Outsanding bills payable—

Water power	$ 98,921.84
Conduit construction	280,069.56
Conduit construction—	
Bills payable	5,532.55
	$384,523.95

The outstanding bills payable on capital account is one of the items noted above, but shows an increased amount.

The conduit expenditure was omitted previously because it was thought to belong to an independent city account as being authorized under separate legislation. It is now to be considered part of the Hydro-Electric system.

The stores item was given at $195,065.19 in the first statement. The figure for stores in the present balance sheet is $237,900.14. An inventory is produced showing as of the same time stock valued at $261,034.40. The city officials report that they are now inquiring into these figures.

Joint use of poles investment not in original balance sheet, now appears at $5,344.71.

The depreciation and sinking fund reserves are now given at $117,891.08 instead of $66,149.52.

Differences in stock issues and bank loan appear. They are evidently due to the introduction of the conduit expenditures previously omitted.

The deficits up to 30th April last, formerly given at $111,866.22 are now stated at $142,274.64.

Outstanding accounts as of the 30th April, 1912, had been brought into the revenues of the year 1912-1913. It is said the amount cannot be exactly arrived at so as to be excluded, and that it amounts to a figure in the neighborhood of $7,000.00. The accounts have not been disturbed to meet this point.

In the item above mentioned, accounts receivable, no provision was made for bad debts. These have now been estimated at $7,711.47 and a reserve set up therefore.

Objection was taken by Mr. Scott to the capitalization of the cost of government inspection, installation and removal of meters. The inspection and installation are to remain as capital items, but removals are to go to operating account.

A stores and supplies item not included in the one above referred to, gives rise to difficulty. There stood to the debit of this account the sum of $77,113.45. But the material had, it is said, gone direct into construction in the early stages, without being accounted for through the stores department. The item is now closed by being carried to overhead distribution.

To an equipment account there is charged $27,824.92. So far the facts as to this have not been definitely ascertained. It is said there is no inventory, and the amount should be transferred to a construction account.

Dealing with the accounting system. Mr. Scott says:

"Shortly stated, the expenditures are recorded in the ledgers (capital and operating) kept by Mr. Manley at the city hall. The revenues collected are paid in (including those collected at various centres in the city) to the city treasurer, and the records of the different sources of income from the plant are kept at the King street office, while the stores—a large figure—are kept at James street. There may be advantages in this method—but with me it is an axiom that the only proper place to perform the accounting of any business is where the business is carried on. I think it can be truly affirmed that in the case of an electric light system, the place of business is where orders and contracts for lighting and the supply of current are entered into, bills made out, and records thereof kept and not least, but most, where the manager is to be found. In Winnipeg's case, the place of business in my opinion is the King street office, and it is there that I would recommend the accounting staff to be placed. None can have more pride in the success of the undertaking than the managers in charge, and I think it an altogether unfair handicap if they do not have the accounting staff to appeal to in all matters pertaining to the result of their opertions.

"It need hardly be added that the accounting affairs of the system are such as to demand the services of thoroughly competent accountants, who will be free to give their whole

time and energies to the work, and who will be prepared to make a study of electric light accounting, and as soon as may be inaugurate whatever needed cost and other accounting may be necessary to keep pace with the development of the undertaking in its various departments."

City of Winnipeg Hydro-Electric System, Year Ending April 30, 1913

Operating Revenues—	
Commercial lighting	$286,437.50
Commercial power	71,954.59
Municipal street lighting	28,921.94
Municipal buildings lighting	13,662.35
Municipal power—waterworks	64,198.27
Municipal power—Miscellaneous	2,467.82
Tramway earnings	6,649.13
Accounts receivable at 30th April, 1913	70,444.43
	$544,736.03
Operating Expenses—	
Power (schedule)	$25,616.70
Transmission and transformation (schedule)	37,573.81
Distribution (schedule)	41,969.76
Consumption (schedule)	6,947.14
Commercial (schedule)	64,701.54
General (schedule)	17,079.15
Tramway (schedule)	17,035.58
Undistributed (schedule)	54,220.41
	$245,144.09
Depreciation six months (credited to depreciation reserve)	$99,662.32
Taxes	3,045.93
	$102,708.25
Total operating expenses	$347,852.34
Net operating revenue	196,883.69
Non-operating revenues	908.15
Income	$197,791.84
Deductions from income—	
Interest on funded debt	210,649.55
Interest on floating debt	70,575.19
(Contractural sinking fund requirements, $43,843.30 charged to depreciation reserve)	281,224.74
Deficit for year	$83,432.90
Deficit at beginning of year	58,841.74
Deficit at close of year (as per balance sheet)	$142,274.64

Balance Sheet as at 30th April, 1913

ASSETS

Property and Plant—	
Water power construction	$3,605,321.39
Distribution system	2,012,796.79
Hydro-electric system extension	19,691.00
	$5,637,809.18
Discount and expenses, stock and debentures sold	121,359.91
	$5,759,169.09
Conduits	280,069.36
Accounts Payable—	
Water power	98,921.84
Conduits	5,532.55
	$6,143,693.04
Current Assets—	
Accounts receivable	$70,444.43
Stores	237,900.14
Electrical appliances	3,408.20
	$311,752.77
Investments—	
Sinking fund trustees	$20,436.52
Other Assets—	
City and Winnipeg Electric Railway, joint use of poles	$5,344.71
Consumers wiring and installations	163.88
Deficit	$142,274.64
	$6,623,665.56

LIABILITIES

Stock and debentures	$6,542,000.00
Less unsold at 30th April, 1913	934,375.00
	$5,607,625.00
Current Liabilities—	
Accounts payable	160,548.67
Bank of Montreal	694,039.79
	$854,588.46
Accrued Liabilities—	
Unmatured interest on debenture debt	35,849.55
Depreciation reserves	117,891.08
Uncollectable accounts	7,711.47
	$6,623,665.56

Personal

Mr. A. L. Mudge has returned from England where he has spent a few weeks combining business with pleasure.

Mr. E. W. Sayer, of the Sayer Electric Company, Montreal, is a candidate for alderman of the St. Lawrence Ward.

Prof. L. A. Herdt, of McGill University, has been appointed by the city of Quebec to advise on electrical conditions in that city.

Mr. Herbert S. Holt, president of the Montreal Light, Heat and Power Company, has been appointed a member of the McGill University Board.

Mr. J. D. Lachapelle has severed his connection with R. E. T. Pringle and will continue the business of engineers and manufacturers' agents under the name of J. D. Lachapelle & Company with offices at 519 Canadian Express Building, Montreal. Mr. Lachapelle is well known in the Canadian electrical field having been associated with the electrical busi-

Mr. E. J. Latta, for the past two years on the editorial staff of the Electrical Review & Western Electrician, has entered the employ of the Underwriters' Laboratories as special agent and will spend most of his time on the road for this organization. Mr. Latta brings much experience both of a technical and practical nature to his new work. He is a graduate of the University of North Carolina and of the Graduate School of Harvard University, and has at various times held important positions with the Westinghouse Companies, the University of North Carolina and the General Electric Company.

Never mind reverses if they come. Fight on Keep on, on, on, meeting success without exultation, facing reverse without despondency.

An Electric Hoisting Installation

The Dominion Coal Company have recently installed an electric hoisting engine in their New Waterford collieries and a brief description of the equipment will prove interesting to those connected with modern colliery hoisting practice.

Electrically-operated hoisting engines belong to three distinct groupings: Ward Leonard, Ilgner, and straight 3-phase. The engine described herewith, known as a No. 14 colliery hoisting engine, is designed to work in the first grouping, and this article will explain the Ward Leonard operation from the point where the Dominion Coal Company's high tension transmission lines enter the hoisting engine house. This building is built high enough to allow for a ten-ton travelling crane which is used to move the heaviest part of the machinery without being cramped for room.

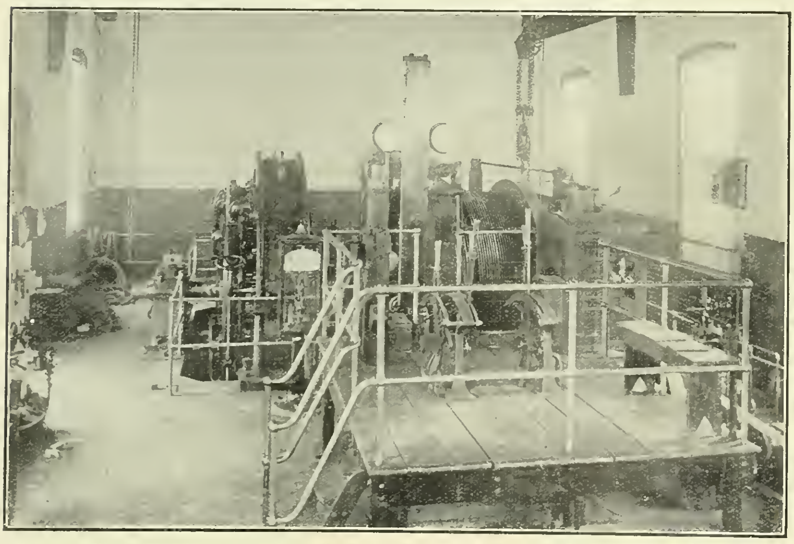
As the Dominion Coal Company's current supply is high voltage, alternating current, a motor generator set has been installed. This consists of an 800 h.p. slip-ring induction motor directly coupled on the same shaft with a variable voltage d.c. generator, 0-600 volts; also an overhung type exciter, which supplies the exciting currents to the variable voltage generator and the separately excited field of the low speed direct current winding motor. The motor operates at 740 r.p.m., on 6600 volt, 25 cycle current. The current for this motor comes into a single concrete cell section built in the basement of the engine house, and passes through isolating links and an oil switch which is operated by remote lever control from the high tension switch panel on the engine room floor above. Current and potential transformers are used in connection with the circuit for measuring the necessary power. This motor is supplied with special short-circuiting device so that when the set has been gradually run up to speed by a small liquid starting apparatus the slip-rings are short-circuited, the starter is cut out of circuit, and the brushes automatically lifted from the slip-rings. Running under such conditions, the motor works most efficiently because no external leads offer resistance to motor currents. Further, there is no wearing of slip-rings or brushes which is important considering that the set runs continuously day and night throughout the six working days of every week in the year.

The generator is a variable voltage type capable of supplying 0-600 volts to the winding motor, the normal current being 980 amperes to 1850 maximum during acceleration or what is termed "peak load." This generator is of the ordinary shunt wound type with commutation poles and has also a compensating winding for eliminating armature reaction. A special feature is a double section air-cooled commutator —the fan is built between the commutator sections in such a manner that each fan blade connects opposite commutator segments. The commutator is hollow and air, drawn through by the fan, keeps the commutator cool whatever the load or atmospheric temperature conditions in the engine house.

The exciter is a small overhung compounded generator working at 230 volts, which supplies all the necessary exciting current to distributing busbars mounted on a low tension direct current panel next to the high tension panel on the engine room floor. Fixed to the end of the overhung exciter is a centrifugal switch which automatically stops the winder should the converter set tend to run about 15 per cent over speed.

The main armature connections of the variable voltage generator and winding motor are electrically coupled without the interposition of switches. The winding motor is for a peak load of 1320 h.p. and is somewhat similar in construction to the variable voltage generator having interpoles and compensating winding. It is a large slow speed multipolar machine rigidly coupled to the shaft of the winding drum.

The winding drum is 8 ft. in diameter, and the rope tread is cylindrical and of solid cast steel section. Each side of the drum has a steel plate brake-path 9 ft. in diameter, bolted to the main drum casting. Two pairs of hardwood lined brake posts engage with the brake paths of the drum. Both brake post units are mechanically linked so that one brake lever operates both simultaneously. The Whitmore patent "take up" gear is fitted and this automatically takes up any wear of the wooden blocks and always keeps the air gap, when the brakes are off, equal. Thus the power of the brakes remains the same for any wear of the wooden blocks. The brake engine is supplied with air from a small electrically driven compressor, which automatically stops and starts as the air pressure rises and falls beyond the fixed limiting values by an air operated piston switch in the motor armature circuit. The current for the motor is taken from the low tension panel exciter busbars.



Hoisting equipment in New Waterford collieries—Dominion Coal Company.

The driver operates the whole mechanism from the platform with perfect accuracy and without any physical exertion.

Before him are three levers, (1) the lever which operates the Ward Leonard rheostatic controller, the resistance of which is in series with the field of the variable voltage generator, (2) the lever which applies the mechanical brakes, and (3) the lever which cuts

current off the winding motor and automatically applies the brakes through tripping links. This lever is termed the emergency brake lever. The emergency brake also comes into operation automatically from the following causes. (1) In the event of an overwind, (2) if the transmission supply power fails, (3) if the air operating the brake engine fails, (4) if the winding motor is overloaded more than a certain allowable amount, (5) if the converter set overspreads more than a certain allowable amount, (6) if the excitation current fails.

In front of the driver, a column depth indicator is placed, by means of which the driver sees exactly the position of boxes on the main slope track. The safety gear on this depth indicator is in direct lever connection with Ward Leonard lever No. 1, and prevents the driver accelerating too rapidly or overwinding, and in the case of vertical shafts also prevents him retarding the winding motor too quickly. The counter shaft of the indicator also drives a tachograph.

In the Ward Leonard system, the mechanical brakes during normal operation are only used to "hold" the load. Braking is done rheostatically with the electrically coupled armatures of the winding motor and variable voltage generator. It is almost impossible for the driver to make a mistake and perfect safety is assured when winding men.

The No. 14 engine is designed to hoist 185 short tons of coal per hour up a 25 per cent. gradient shaft 5,000 feet long at 30 ft. per second. The No. 14 slope at present has only a single track and the engine hoists coal from any landing, sending the empty boxes back into the mine under unbalanced load conditions, so that the converter induction motor is caused to run above synchronous speed, and power to the value of 150 kw., when rope speed is at 30 ft. per sec., is pumped back on the transmission lines. The greater the unbalanced load, of course, the greater the amount of power returned to the line.

The record of this engine up to the present is 1860 boxes in ten hours working and the average weight of coal per truck is 2,000 lbs.

The whole of the above equipment was supplied and installed by the Siemens Company of Canada, Limited, who have also delivered or have on order two 1900 h.p. and one 400 h.p. peak load electric hoisting engines for the same company.

Megantic to Have Hydro Plant

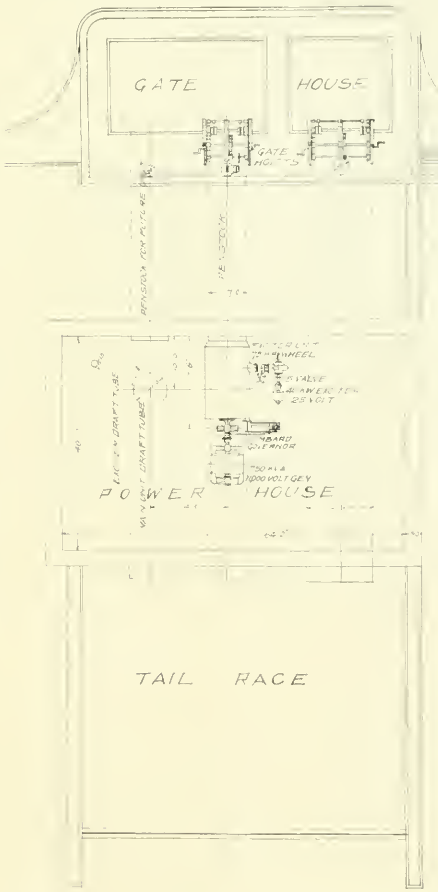
The corporation of the town of Megantic are installing a hydro-electric plant according to plans shown herewith. It will be seen that the power house and auxiliary works are planned for two units of 750 kv.a. capacity, but only one of these will be installed immediately. The dam will be of concrete, 625 feet in length with an overflow crest of 325 feet and a head of 30 feet. The water will be carried by a 7-foot penstock for each of the generating units. Each turbine will consist of one pair of 30-inch wheels and will have a normal rated capacity of 1,250 h.p. at 450 r.p.m.

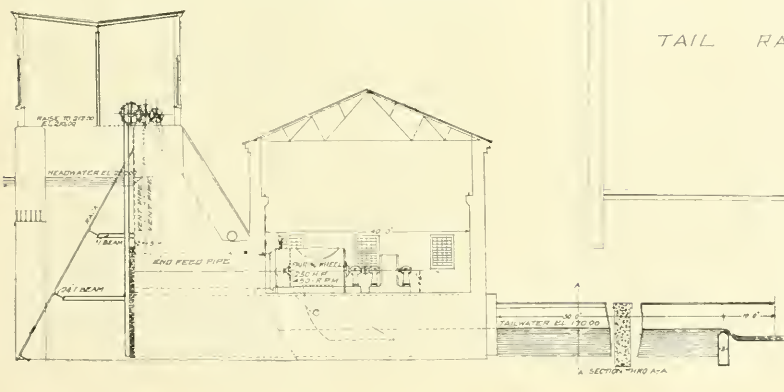
The exciters, of which there will be one for each unit, will be 40 kw. capacity, 125 volts. These will be driven by 75 h.p. wheels, the water being fed to these by a branch from the large penstock. After passing through the exciter turbine the water will discharge into the draft tube of the main unit to which it corresponds. Each turbine will be ergulated by a Lombard governor.

The generators, only one of which is being installed at present, are of the horizontal type, 750 kv.a. capacity, 11,000 volts. There will thus be no step-up transformer equipment required as transmission is at this voltage.

As shown in the power house section, the main building is being planned for the installation of a travelling crane.

Mr. Edward A. Evans, Mem. Can. Soc. C. E., is consulting engineer for the corporation of Megantic.





Section and plan of Municipal water plant being installed for Megantic, P Q.

Testing of Telephone and Telegraph Lines

By Mr. T. H. Nicholson

Line Testing With a Voltmeter

It would not be practicable to simply have a voltmeter and connect it to a line when a test is required, without having some convenient means of quickly changing the circuit for the various conditions met with, and so obtain a complete test. Therefore, it is customary to arrange a series of switches or keys so designed that when one key, or a definite combination of keys, is operated, a certain known condition of the voltmeter circuit is in effect. Then again it is necessary to transfer the talking and ringing circuits on to the line, or to use them in connection with the test circuit. It would seem then that the design of a testing keyboard is quite an important matter, and just as necessary as suitable instruments and efficient methods.

There are two general methods or principles employed in testing circuits. The older of these is to use a battery that is permanently grounded, and with a circuit that connects the free end of the voltmeter circuit alternately on each side of the line, with another ground connected on the opposite side to test across.

Fig. 16 shows a skeleton circuit of this arrangement and illustrates the method of changing the circuit by means of ordinary telephone keys. For the sake of simplicity, all other keys, such as those used for connecting the shunt coil, for talking, listening, etc., have been omitted. When the VM key is operated, the battery flows through the voltmeter and reverse key directly to L_2 on the line, and if a ground is on that wire the voltmeter will be deflected to an extent depending on the resistance of the short circuit and of the earth return itself. When the VM and reverse keys are both operated the testing battery similarly flows to the L_1 side of the line, and likewise to any "ground" that may exist on that wire. When the "VM" and "ground" keys are operated the battery flows out over L_2 as in the first instance, and, if there is a cross between L_1 and L_2, back over

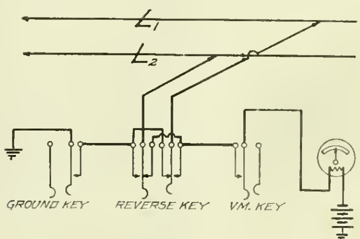


Fig. 16

L_1 to the ground applied by ground key. If the reverse key is operated during this test the only result is to reverse the direction of current.

Figures 17, 18 and 19 show the actual circuit condition when making these tests, and show how the fault, as denoted by "X" in each case, is detected. In Fig. 17 the voltmeter, when applied to L_2 with the "VM" key, is deflected a certain amount, showing a ground to exist on that wire. Similarly when the "reverse" key is operated and the circuit is changed as in Fig. 18, a ground is shown on L_1, and when the "VM" and "ground" keys are operated a cross is detected as shown in Fig. 19.

Referring to Fig. 17 and assuming that the deflection was 20 on a 30-volt scale, 1000 ohm instrument, it would seem that the "ground" according to the rule already given, must be at a point on the wire corresponding to 500 ohms, but on trying to locate this from the known length of the line, this calculated point is found to be some distance beyond the end of the line. Obviously then there must be some resistance in the cross between the wire and ground. This is nearly always the case, and it is therefore necessary to determine this extra resistance in order to make an actual location.

This can be done directly with a Wheatstone bridge, but it is often desirable that it be done with a voltmeter, and as

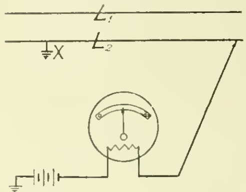


Fig. 17

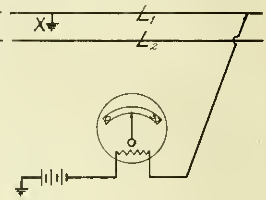


Fig. 18

there are probably quite a number of testboards using this general principle of testing, a method of making this location is given herewith.

The L_2 side of the line, as assumed above, shows a resistance to ground, which we may call "X," of 500 ohms. A subscriber is called, and while he has his receiver off the hook the voltmeter is applied to the L_1 side of line as shown in Fig. 20, where the cross at the end of line represents the sub-station. A deflection of 16 is now obtained, giving a resistance of 875 ohms. This resistance, which we will call "Y," includes the L_1 side of the line, the sub-station, that part of L_2 from the sub-station to the "ground," and the "ground" itself. If we ignore the resistance of the "ground" the line must measure $Y + X$ or $875 + 500 = 1375$ ohms.

Now, from a separate test, or from the records, we know that the line, including the sub-station, only measures 775 ohms, so the difference must be due to the resistance of the ground. This difference, $1375 - 775 = 600$ must be divided by 2 since the ground was twice measured, once over L_2 and again over L_1. The actual resistance of the ground then is 300 ohms. Since 500 ohms include L_2 to the ground and the ground itself, the remainder, 200 ohms, is therefore the resistance of L_2 to the cross.

Evidently a ground on the L_1 side can be located equally

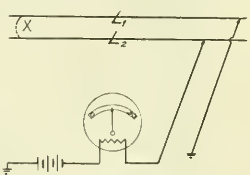


Fig. 19

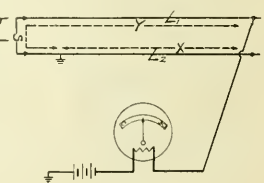


Fig. 20

well by reversing the operation, but it is a difficult proposition to determine the resistance of a cross between L_1 and L_2. Fortunately, however, a cross between the two wires of a line is usually of a low resistance, and it can safely be ignored in determining the location of it.

(to be continued)

Electric Railways

The Operation of Motor Buses

The question of the operation of motor buses in the city of New York was the cause of a report recently made on bus operation in London, Eng., and Paris. The report is by Mr. J. A. McCollum, assistant engineer of the Bureau of Franchises, and was submitted to Mayor Kline during the early part of November.

The report covers the situation in London and Paris pretty thoroughly but is not enthusiastic on the operation of motor buses in opposition to electric tramways. It is shown that the bus cuts into the earnings of the railways where they are allowed a free choice of route, but the operating costs are high and absorb a very large percentage of the gross earnings. Under the head of operating costs, figures are given on a system which covered over 1,250,000 miles in 1912 and where the total cost per car mile worked out to 14.264c. This was a London system. A Paris company has given out figures which show the average cost per car mile as 21.66c. The percentage of gross receipts required for operation seems to be in the neighborhood of 90 per cent. and in some cases is much higher than this. This, however, is offset by the smaller capital required to carry the same number of passengers which would be in the ratio of about 1 to 3. These cars cost anywhere from $2,500 each, if purchased in large quantities, up to $4,000 or more. The life of the motor bus has been estimated at 10 or 12 years but experience up to the present time has shown that the vehicle becomes obsolete after five or six years' use. When the design becomes more standardized this time may, however, be lengthened.

The number of fatal accidents caused by the motor bus is considerably greater than that caused by the tramcars for the same number of people carried, and the report states that "a very serious disproportion of fatalities caused by motor omnibuses is shown." Another objection to the buses is that the cost of maintaining the road bed is largely increased. The greater weight of the vehicles and the increased speed have been the cause of breaking up foundations which had naturally been laid to carry a lighter traffic. Mr. McCollum remarks that "New York should proceed slowly in permitting motor buses to operate on its streets and should be particularly careful in regulating the conditions of franchise and operation." The report closes with a summary discussion and comparison as follows:—

(1) The motor bus is independent of a large complicated system outside of the vehicle itself; it is itself a complete traffic unit.

(2) It can easily adapt its movements to street traffic.

(3) Not being confined to a fixed track, vehicles may run side by side, thus clearing dense traffic intersections much more rapidly than the surface electric railway cars.

(4) Routes may easily be changed, either temporarily or permanently—temporarily when there is obstruction due to fire, parades, etc.; permanently when desirable because of change of traffic conditions, making other routes more desirable to the travelling public, and without loss of investment in permanent street structures.

(5) Passengers entering or leaving buses may do so at the curb without risk of crossing dangerous street traffic.

(6) The breakdown of one vehicle in the street does not derange the service of other vehicles of the same system.

(7) Point to point speed somewhat exceeds that of the street car without exceeding maximum speed of the street car.

On the other hand, it may be said that the motor bus has also its disadvantages, when compared with the street surface car.

(1) It is a constant source of accidents. London statistics show it to be much more so than other fast-moving vehicles.

(2) The motor bus, because of its limited capacity, is unable to provide rush-hour facilities as effectively as the street car of larger capacity. (This is on the assumption that the weight and capacity of motor vehicles are rigidly limited, as in London.)

(3) The capacity of the motor bus being less than that of the street car, more moving vehicles in the street are necessary to do the same amount of work, thereby increasing the liability to accidents.

(4) When operated in large numbers, the motor bus will require more rigid regulation by the municipal authorities as to type of vehicle and method of operation.

(5) Less comfort to passengers, due to vibration. This vibration increases as the street surface becomes more uneven.

The report also adds the following suggestions —

(1) Motor buses should be excluded from streets having macadam pavement and permitted only on pavement having a heavy foundation. The weight of the vehicle should not exceed that permitted by police regulation of London.

(2) Power should be retained by the franchise whereby the construction, size, power, etc., of the vehicle can be controlled, with the right to change any rules when experience shows that such change will be of benefit.

(3) Rate of fare should depend somewhat on distance travelled.

(4) No advertising signs should be permitted on the outside of omnibuses.

(5) Rate of speed should be limited, not by a maximum speed limit only, but in regard to dangerous or reckless driving as well.

(6) Upkeep of vehicles should be insisted upon with a penalty provided for failure to comply with rules in regard thereto, and thorough municipal inspection should be maintained.

London and South Western Railway Electrification

Work is just commencing on the electrification of the suburban lines of the London & South Western Railway Company. The generating plant will consist of six 5,000 kw., 3-phase, 1,500 r.p.m., 11,000 volt turbo-generator units. Power will be supplied at the generated voltage to nine substations by three-core cables which will be paper insulated,

lead sheathed and wire armoured and be carried on posts beside the line, circuits being so arranged as to afford a duplicate supply to all sub-stations. Each sub-station will contain transformers and rotary-converters for transforming to 600 volts d.c. The size of the converters will be, the larger 1875 and the smaller 1750 kw. The 600 volt current will be supplied to a third conductor rail which will be installed parallel to the line 16 inches from gauge and at such a height that the contact surface will be three inches above the rail level. This rail will be of special steel having a resistance about 6¾ times that of copper and weighing 100 lbs. per yard. It will be supported by insulators fixed to the sleepers and copper bonded. The current will be collected by cast steel collector shoes hung from the trucks. The running rails will of course form the return circuit and on these flexible copper bonds will be installed.

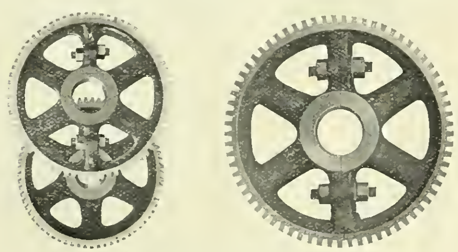
For the first section of the line 84 train units are being provided. Each unit will consist of three compartment type coaches and will be equipped with four motors each of 275 h.p. claimed to be the largest ever mounted on a passenger cab. A special motor truck carrying two of these motors will be fixed under each end of the train unit, the remaining trucks being of standard pattern. The control apparatus will be of the relay automatic multiple type provided for uniform acceleration and controlling, from the driving cab, all motors on a train of any length.

It is expected that the first section of this road will be in operation by the end of 1914. The electrical work is in charge of Mr. Herbert Jones the company's electrical engineer. The electrical equipment for the train units is being supplied by the British Westinghouse Electric & Manufacturing Company. The manager of the system is Mr. H. A. Walker.

Railway Six-Spoke Gears

A recent development in railway-motor gearing is the Nuttal design of a six-spoke cast-steel gear, which can be furnished either split or solid. This style of gear has six elliptical spokes instead of four ribbed spokes as in the older designs. The ribbed spoke has much thinner sections than any other part of the gear, causing unequal cooling of the casting in the mold with the consequent formation of shrinkage stresses and sometimes actual shrinkage cracks. The section of the elliptical spoke is practically the same as the rest of the casting, allowing a uniform rate of cooling and reducing internal stresses in the material to a minimum.

The six-spoke gear weighs from five to seven per cent. less than the old style gears of the same size and type. This



Six-spoke cast steel gears.

reduction in weight is largely due to the elimination of useless metal in the ribs and web. The new gear is somewhat lower in first cost and reduces operating expenses, as there is less dead weight to carry.

The six-spoke split gear has four 1¼-inch bolts, two on each side, about midway between the hub and rim. This gives ample rigidity and greatly facilitates assembling, as the nuts are readily accessible to any type of wrench. Stud bolts are used, the bolt being fitted into a tapped hole in one-half of the gear and held to the other half by a nut. The adjacent bolt is reversed, thus placing one nut on each side of the spoke and avoiding interference with wrench clearance by the nut of the other bolt. This method of bolting has been used for some time with complete success.

Cast-steel gears of this style can be furnished in any type and grade previously furnished in the old designs. Briefly the chief advantages of the new design are absence of shrinkage strains or cracks, greater solidity of metal throughout the casting giving added strength and reliability, lighter weight without sacrificing strength, lower cost, ease of assembly and uniformity of design throughout the entire range of sizes and types of gears.

The R. D. Nuttal Company, Pittsburgh, Pa., U.S.A., largest manufacturers of gears in the world, built the above mentioned gears.

An Inspection Pit Safety Device

The protection of employees has received a large amount of consideration in the Jersey City shops of the Hudson & Manhattan Railroad, which are in charge of P. V. See, superintendent of car equipment. One of the safety devices in use there is an automatic apparatus which replaces the time-honored practice of calling out in a more or less audible voice "Juice on car No. 732" before the current is put on a car. The new contrivance not only gives a clear warning whistle ten seconds before the current is put on the cars,

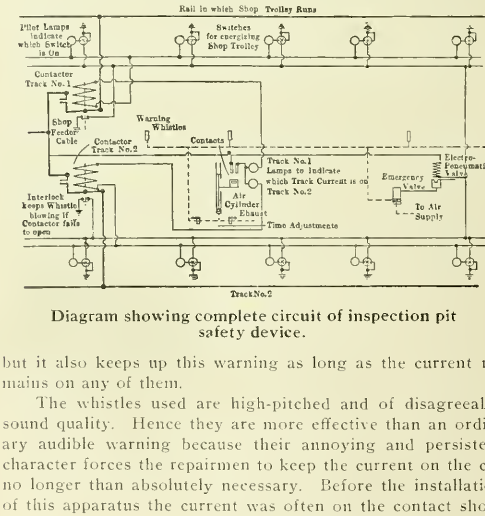


Diagram showing complete circuit of inspection pit safety device.

but it also keeps up this warning as long as the current remains on any of them.

The whistles used are high-pitched and of disagreeable sound quality. Hence they are more effective than an ordinary audible warning because their annoying and persistent character forces the repairmen to keep the current on the car no longer than absolutely necessary. Before the installation of this apparatus the current was often on the contact shoes for an hour or two at a time. Now the cars are not alive more than ten or fifteen minutes a day and usually about one minute at a time.

The apparatus consists of four Westinghouse air signal whistles which are equally placed throughout the length of the 400-ft. inspection pit, one electropneumatic valve, two contractors and one piston with contacts. The accompanying diagram shows the complete circuit. When a switchman desires to move a car he proceeds as follows:

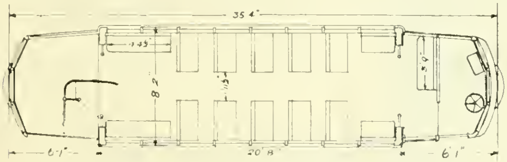
He first puts the Coburn trolley, which is dead, into the car and turns on one of the snap switches which are mounted on the wall, as illustrated. This switch has a double circuit, one point making a ground for the No. 1 or No. 2 contactor shown, depending on the side of the car-house. The same switch also completes the circuit for the magnets which

operate the air whistles, by grounding them. The whistles then start to blow.

On the air line with the whistles is a brass tube with piston which is connected to a heavy weight. A small adjustable leakage valve near this piston regulates the building up of the air-pressure in this line. As the pressure increases it raises the piston and weight. Four contact fingers are fastened on this weight. When the piston is raised to the top of its stroke it makes contact with two other fingers, thereby completing the circuit for the No. 1 or No. 2 contractor, picking it up and energizing the trolley. When the switchman turns off the snap switch the trolley removed from the car is no longer alive, and there is no possibility that the operator will receive a shock should the insulation on the cable be defective.—Electric Railway Journal.

New Cars for London

The London Street Railway Company are placing in operation a half-dozen single truck, single end, p. a. y. e. cars. The plan of the car is shown herewith. The overall length is 33 ft. 4 in.; the body 20 ft. 8 in.; the width over sheathing 8 ft. 2 in.; width of aisle 1 ft. 11½ in.; length of vestibule, both front and rear, 6 ft. 1 in. Each car has ten transverse seats, two longitudinal seats to accommodate two persons each, and two longitudinal seats placed at the rear of the car to accommodate three persons each. A seat to accommodate three has also been placed in the front vestibule backing the motorman.



Plan of London's new P. A. Y. E. cars.

The under framing is constructed entirely of steel the main members consisting of 3-16 inch plates 15 inches wide, one on each side of the car and reinforced at the bottom with an angle. Every effort has been made to give the frame strength to resist end or cross strains. The cars were built according to designs furnished by Mr. C. B. King, the general manager of the system who has made a special study of the requirements.

Toronto Railway Renewals

Considerable renewal work is being done by the Toronto Railway Company at various points throughout the city at the present time and the following notes will be of interest as indicating the system in use. By franchise agreement the roadbed is prepared by the municipality the company only placing the rails. Wooden blocks are now being used.

In order to form a solid bed the roadway is first excavoted to the depth of 22 inches. In the bottom of this excavation a 9-inch bed of concrete is laid. The concrete is mixed in the proportion of one part cement, two of sand and seven of stone. On top of this bed the cedar ties are laid which are 6 in. deep, and spaced from 2 ft. to 2½ ft. apart. These ties are held firmly in place by a second bed of concrete of the same consistency as the first one. This bed is the same depth as the ties, thus forming a level surface on which to lay the rails.

On the straight track there are two kinds of rail used depending upon the traffic to which they are subjected—one an 80 lb. T rail, No. 335, the other a 90 lb. girder rail, No. 392. On the curves where the stress where the stress is greatest a 108 lb. guard rail is used. These rails are manufactured by the Lorain Manufacturing Company, of Ohio. The rails are bonded at every joint by means of a bond constructed of copper strands and riveted to the rail at each end. In addition to these, intersection cables are used at the curves. These cables consist of four interconnected copper wires soldered to the four intersecting rails. Equalizing bonds are placed every thousand feet along the track.

When the rails have been laid and bonded the track is filled up level with the top of the rails by means of wooden blocks and the cracks poured full of asphalt. The blocks are so laid that they form a ½-in. arched surface.

When a portion of track is to be repaired the cars are deflected to one side by laying a temporary track the length of the part to be repaired. The track now used for this purpose is the Kerwin portable cross-over. This cross-over is very convenient as it can be quickly moved by means of a crane car. In cold weather when there is no danger of the track's sinking in the asphalt, track rods are placed on the asphalt and the track laid on these. In places where the pavement is arched the sidewalk side of the track is built up by means of planks. In warm weather the pavement must be covered with plank before the track rods are laid as the heat causes these rods to sink into the asphalt. This method of deflecting the cars along a temporary side track is much more satisfactory than the old way of sending the cars around another route as the temporary track can be left until the cement is thoroughly dry, and the cars still run on the same streets and schedule.

The Montreal Board of Control have referred to the city engineers the two schemes for underground subways submitted by the Montreal Tramways Company and the Canadian Autobus Company. Further details have been requested, and when these are received a board of engineers will be appointed to report on the plans.

The Montreal and Southern Counties Railway have let contracts for ten new cars, intended for their extensions. The cars will be of a slightly different type to those in general use on the system. They will be longer, the bodies higher, and with through platforms. They will be, however, of the multiple unit single control type. The contract for the bodies has been secured by the National Steel Car Company, Hamilton, while the Canadian Westinghouse Company will supply the electrical equipment, consisting of motors, air brakes and HL control apparatus.

The Court of Appeals, Montreal, have heard arguments in the case of the Montreal Tramways vs. the Quebec Public Utilities Commission. The latter ordered the company to give detailed information relative to the service, number of cars, earnings, lines, etc., and the directors declined to do so on the ground that the Commission had no jurisdiction. It was contended before the Court of Appeals that under the contracts with the various municipalities it is provided that any disputes or differences, or alleged failure on the part of either the company or the municipalities to fulfil the obligations, the Recorder's Court enjoys exclusive jurisdiction in dealing with such disputes. For the Public Utilities Commission it was argued that the Commission was exercising supervising and governing powers specially conferred upon it by the legislature, and it was thus constituted an extraordinary tribunal set up for purposes of public interest—which was superior to private interest. It was clearly intended that a simple contract between the company and a municipality should not over-ride the jurisdiction of the Commission. Judgment will be given later.

Illumination

Factory Illumination

The illustration herewith represents a direct lighting system recently installed in one of the service station plants of the Ford Motor Company. It may be taken for granted that this company would install the system calculated to give good illumination at the least possible cost. A corner

Fig. 1

of the factory is shown in Fig. 1. The system consists of silvered one-piece, glazed reflectors, each carrying one 100-watt clear bulb tungsten lamp. The station is divided into bays measuring 25 ft. x 28 ft., and in each of these bays four units are installed placed 11 ft. 6 in. from the floor and 12 ft. 6 in. and 14 ft. apart. These dimensions are shown in Figs. 2 and 3. The ceilings in this case are white and the floor is of concrete.

As stated above four 100-watt lamps are used to each bay, that is, 400 watts to 700 feet or an expenditure of .57 watts per square foot. The following figures are the results obtained from 19 photometric tests taken at points indicated by the small dots in Fig. 3. It will be noted that these tests are extremely uniform, ranging only between 3.96 and 4.25 foot-candles, with an average of 4.13.

Illumination Readings

Test Station No.	Foot-candles
1	4.18
2	4.10
3	4.16
4	4.13
5	3.96
6	4.20
7	4.07
8	4.20
9	4.25
10	4.21
11	4.19
12	4.00
13	4.21
14	4.22
15	4.03
16	4.15
17	4.07
18	4.07
19	4.15
Average	4.13

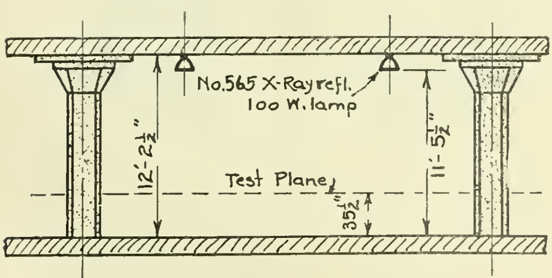


Fig. 2—Section of bay on 3rd floor.

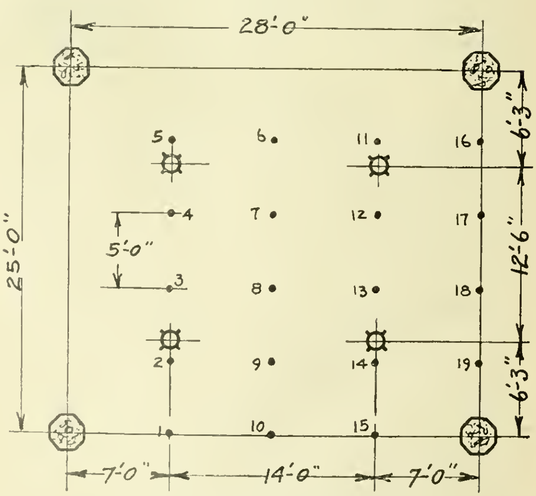


Fig. 3—Plan of bay.
Location of lamps and test stations marked.

The reflectors installed in this building are known as the beehive type and were supplied by the National X ray Reflector Company. These reflectors, illustrated in Fig. 4, are made of glass, in one piece, with a coating of silver outside, which is protected by a green elastic enamel backing.

Fig. 4

The inner surface of the reflector is given a fire glaze which makes the cleaning process a simple matter, since it is only necessary to wipe out the reflector with a dry cloth.

Composite Street Lighting

The diagram shown in Fig. 1 represents a complex lighting service circuit operating in Wilkinsburg, Pa., and described in a current issue of Lighting Journal by Mr. Geo. W. Roosa, of the Westinghouse Company. This system is an admirable example of the flexibility of modern street lighting units, for not only have they installed lamps of various current ratings on the same circuit but also arc lamps and tungsten lamps of different candle power. As indicated in Fig. 1, the circuit contains a number of 80 c.p. 7.5 ammeter tungstens, a number of 200 c.p. 7.5 ammeter tungstens and a number of 10 ammeter a.c. series flame carbon arcs. To adapt the ten-ammeter arc lamps to the 7.5 ammeter circuit, as required by the tungstens, series auto-transformers were inserted above each arc lamp as shown in the figure. In some cases the auto-transformer has been mounted on the mast arm or even at the pole instead of directly above the lamps which gives additional height to the lamp and decreases the weight of the apparatus on the end of the mast arm. It is the intention of the lighting company to place all auto-transformers at the pole eventually, as, in addition, the lamp man can attend to the lamps while the line is alive as he can short circuit the secondary of the auto-transformer and cut the lamp completely from the line.

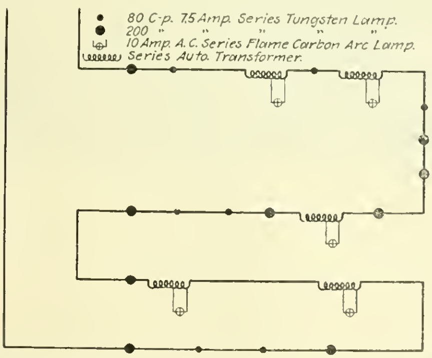


Diagram of complex series circuit containing 10 ampere flame carbon arc lamps, 7.5 amp., 80 c.p. and 75 amp. 200 c.p. street series tungstens

The article states that this system has been found most advantageous in Wilkinsburg as different types of lamp are required at different points. At street corners where there are no trees the arcs are used; on hilly streets or where foliage is low and thick the tungsten lamps placed closer together give much better results.

Combination Railway and Light Poles

The city of Niagara Falls, New York, has just completed the installation of a number of combination railway and lighting poles. The poles are of 7 in., 6 in., and 5 in. standard weight tubing and present a very handsome appearance. These poles have all been provided with a slot below the ground level so that if at any time in the future it is decided to run wires underground these can be removed from the top of the poles where they are now placed and run in conduit below the sidewalk level and up the poles with a minimum of expense. In the brackets used on these poles provision has been made to take positive cutout. It is not necessary to remove any portion of this bracket to operate the cutout as a small chain and ring extending below the bracket are provided for this purpose.

A view of Niagara Falls Main Street

The poles for this installation were supplied by the Electric Railway Equipment Company. The lamps used throughout are the General Electric magnetite type. There are 112 poles complete making a total of 224 lamps.

The villages of Bolton, Thistledown and Woodbridge are at present agitating for electric energy and the Hydro-electric Power Commission of Ontario have already submitted a system covering Bolton and Woodbridge. The rate is understood to be in the neighborhood of $14.00 at distribution voltage. It is suggested that the distribution could be made from the Weston sub-station.

The Dealer and Contractor

The Wiring and Illumination of Freight Sheds

The Canadian Pacific Railway Company have just completed their new freight sheds, said to be the largest in Canada, on the corner of King and Simcoe streets, Toronto, of which the illumination forms a very important feature as these buildings are in use practically twenty-four hours every day. The buildings consist of an "inbound" shed approximately 900 feet long by 50 feet wide; a transfer platform 900 feet long, and an "outbound" shed approximately 900 feet by 30 feet. A small part of a horizontal section through these sheds, shown in Fig. 1, will represent their relative location and also the location of the lighting units and the different outlets.

The inbound shed consists of bays, 15 ft. x 50 ft., as shown in Fig. 1. It is lighted by suspended units, 60 watts each, with 14-inch flat porcelain reflectors placed as indicated by the circles in the drawing. There is a second storey to the inbound shed, but in this storey only two lamps are used in each bay, the arrangement being as shown in Fig. 1 in the outbound shed. Three lines of cars may be drawn up between the inbound shed and the transfer platform, and three lines between the platform and the outbound shed. These cars can be lighted by portable lamps, enclosed in wire guards, and having a sufficient length of flexible cord to reach to the nearest side pillars of the inbound shed, on the one side, and the nearest side pillars of the outbound shed on the other side, where push type receptacles have been installed.

The transfer platform also uses 60-watt lamps with the same type of flat porcelain reflectors. In this case, however,

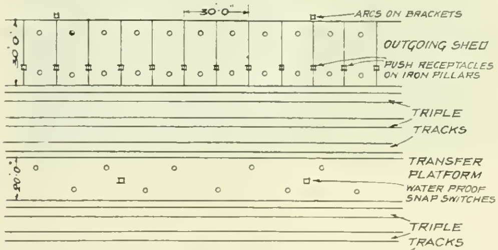


Fig. 1—Plan of sheds.

each lamp is supplied with a shock absorber and is protected by a wire basket. As seen in the drawing the lamps are staggered. 112 lamps are used on this platform, 56 on each side.

The outbound shed consists of bays approximately 30 ft. x 15 ft. and two 60-watt lamps with flat porcelain reflectors are used in each bay as shown. As already explained each pillar on the side next the transfer platform is supplied with a push receptacle so that portable lamps for lighting the cars may be attached.

The wiring throughout is contained in conduit and the shed circuits are controlled in sections from enclosed wall panels placed at convenient points. The arrangement of the transfer platform is somewhat different, its illumination being controlled from snap switches placed at intervals along the platform. These are a weather-proof type, being a combination condulet and snap switch.

Fig. 2—Office lighting.

The sheds are equipped with an intercommunicating telephone system of Northern Electric telephones and a 15-station magneto watchman's clock system manufactured by Munderloh & Company is being put in.

The office lighting is practically uniform, and consists of single chain pendants, each chain carrying a 60-watt lamp surmounted by an Alba shade. The chains are in statuary bronze finish. The photograph shown in Fig. 2 is typical of the installations throughout the offices.

The main switchboard, which is placed in the basement, consists of a single marble panel on which are placed separate three-pole switches for each shed, for the office buildings and for electric water heaters placed in the different toilets. The board also has two ammeters, a volt meter and the Toronto Electric Light Company's wattmeters. The wiring in the office building is also done in conduit but the work is all concealed. In addition to the lighting already explained a number of AB flaming arcs are being installed at different points in the yard north of the outbound shed. A number of these will be placed on brackets outside the outbound shed and between the doorways. Others will be placed on posts so as to light the yards.

The conduit throughout this installation was supplied by

the Conduits Company, Limited; the reflectors by the Benjamin Electric Company; condulets, weather-proof switches and panel boards by the Crouse-Hinds Company; outlet boxes by Thomas & Betts and the Electrical Fittings Company; the brackets and posts for the arc lamps by the Cutter Company; the push switches in the office are Bryant-Perkins type; the wire was supplied by the Imperial Wire & Cable Co.

The electrical equipment of the sheds and offices has been installed throughout by the firm of Harry Alexander, the same firm which carried out the contract for the new Bank of Toronto building, Toronto.

Business-Getting Pointers for Electrical Contractors

By G. E. Shepherd, E. E.

We have all heard it said that the electrical contractor is neither a good merchant nor a good business man. It is not the purpose of this article to enter into a discussion of the merits or demerits of either of these statements. Both are interesting and pertinent and might be taken up with profit to us all. Of the two subjects, however, the one which directly concerns every electrical contractor is that which has to do with the obtaining of new work and the best means of going about it. Just a few thoughts, suggested by a somewhat varied experience covering many years in this particular field, may supply an idea to some and, therefore, be worth while.

To start at the very beginning, a thorough working knowledge of the business is essential. Possessing it, there follows that confidence and assurance, which is another way of saying belief in ourselves, which guarantees success and without which many other qualifications frequently produce only failure.

We must be honest, not alone with ourselves, but with all with whom our business brings us into contact. On this there can be no compromise. A man is known in his community, and his ideas and opinions respected, very largely by reason of his integrity and the knowledge of his work which he is known to possess. Having these things, it follows that his credit stands high and at once his business acquires a reputation for honesty and square dealing which is its very backbone and life. It will carry him through crises where his competitor, not so well esteemed, falls by the wayside.

In this is found the explanation, so difficult for some of us to understand, why one man seems so successful in going after new work, or in interviewing the manager of the central station in his home town, whereas, with seemingly equal energy and an equal knowledge of his work, the other man so frequently fails.

After a few experiences of this kind, the unsuccessful contractor often concludes it must be a question of price and proceeds to cut still further into the already too meagre profits which he so frequently figures. He hasn't realized that he is on the wrong track and is getting still further away from the goal he is striving to reach.

Assuming, however, that our friend has made none of these mistakes, that he has a thorough knowledge of his business, that his ideas of business honor and personal integrity are high, that he is industrious—in short, has all these desirable and necessary qualifications—how shall he go about it to increase the number of contracts on his books?

He has of course taken care to provide a thorough system of accounts. He has a good bookkeeper or has ensured that all records and accounts are promptly and accurately kept. His charges are regularly entered and bills sent out promptly. In short, he is prepared to satisfy any customer making a complaint that he has used all due care in handling his business.

He advertises in his home papers. He does good work only and employs the best mechanics obtainable. The public knows this. He is constantly telling them so and they naturally come to believe it. And here is where your real work begins. When a job is placed in your hands, follow it up—personally, if you can. The interest you manifest in your work is seen to follow the award of the job to you and you follow it through to the finish. You are particular with your work. The public notes that you are not satisfied with a fair job. You are always asking that your workmen turn it out just a little better than your customer expects—and, of course, better than your competitor. You have, in short, built up a reputation for yourself. You find, as did the writer on one occasion, a customer coming to you and saying, "I would like you to wire my building. Tell me what it will cost, but I want you to do it in any case. I am told you will charge me somewhat more than the other fellow, but you are particular with your work and the job will be done right. I like my work done that way and I realize you can't get the best things for the lowest price." And so you have by earnestness of purpose, honesty and square dealing and a thorough knowledge of your work, built up that most valuable of all assets in a successful business, and one which can not be bought—a good name and a good reputation.

Join the associations of your fellow electrical workers. Form a local association in your home town if you have none. Meet and form an intimate acquaintance with all the electrical men in your vicinity. Affiliate with your local civic bodies—your Board of Trade or Chamber of Commerce, Speak up and assert yourself in their deliberations; make yourself well known in your community. Is there a good club in your town? Join it. Meet in a social way in the evening the men who will be the more ready because of the association to give you their business in the office the next morning.

Join the National Electrical Contractors Association. It is the Court of Last Resort in your particular field. Do you share, pay your way; don't keep outside such a splendid organization, refusing your support and yet daily reaping the fruits of the unselfish work of those who constitute its membership.

You won't do it if you are honest with yourself. You have seen that you can't succeed as a business getter if you are a piker. Be liberal, therefore, not only in your views, but with your fellow-workers. Do these things and do them well and satisfaction and success shall be your reward.

—The National Electrical Contractor.

Rico Coasting Time Recorders

A coasting time recorder, an instrument that records the actual number of minutes that an electric car or train is operated without the use of power or brakes, is being placed on the market by the Westinghouse Electric & Mfg. Co. It is an efficient and desirable device to secure greater economy in operating railway equipments. It reads in "coasting minutes," delivering a printed voucher-slip to the motorman at the end of each run. This voucher-slip shows the degree of economy which the motorman has exercised on every run. By a system of ranking or rewards, the railroad company may make a practical and monetary inducement to the men for economical operation, and thus greatly reduce the amount of current ordinarily used in the propulsion of electric cars. Its purpose is to make a motorman substitute brains for sheer muscle.

This device provides an accurate and consistent means of obtaining a record of the amount of coasting secured in the operation of electric railway equipments. The energy input to a car is utilized to overcome the resistor losses in starting, to overcome the losses in the motors and wiring, to impart velocity to the car, and to overcome friction. By far

the larger part of the energy for a service with frequent stops is that required to impart velocity to the car. The momentum thus imparted will keep the car in motion without additional energy if the power is shut off and the car allowed to coast to a complete standstill. Although coasting to a standstill is not practicable for the accomplishment of reasonable schedule service, improvement in economy of current consumption can be effected by the nearest permissible approach to the above condition. The greater the amount of coasting on any given schedule, the less total energy expended for its accomplishment.

The coasting recorder is a simple and reliable automatic device which effectively puts an automatic and impartial check upon each man at all times. It records in coasting minutes, and its object and method of operation are readily understood by the motorman, who soon becomes not only alert in its use but enthusiastic in the support of operation which is increasing his efficiency and actually his earning power. The coasting recorder is an efficient guide for the motorman to operate properly. It provides a continuous check on his operation for each trip.

Attaching Conduit to Cement Ceiling

In our December 1 issue we published a complete description of the installation of exposed conduit wiring in a large factory, one of the most interesting features in which was the method adopted of attaching conduits to the concrete ceiling. The illustrations herewith show other methods that have been employed recently and described in a current issue of the Electrical Review.

Fig. 1 shows how the work was done when a long run consisting of a number of parallel pipes was to be carried along close to the concrete surface. Standard iron expansion cases—which can be bought from any one of several manufacturers—were used to fasten light channel irons to the ceiling, the length of the channel iron being placed at right angles to the direction of the conduit run, and to these pipe clamps for the conduits were fastened in the manner shown in the figure.

The expansion case referred to above consists of a sort of hollow split cylinder, whose two halves are held together at the end which will be nearest the surface of the ceiling when the device has been installed by a narrow band of rather elastic metal. The opening along the centre of the

Fig. 1.

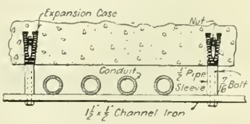


Fig. 2.

cylinder is one that gets larger as the end is approached, so that when a bolt is thrust through the expansion case from the opposite end a nut can be placed on the end of it and pulled slightly down into the expansion case without spreading the sides of the case apart. If thereafter the bolt is turned in such a manner as to draw the nut down into the hollow expansion cylinder, the walls of the latter are flared apart.

Fig. 2 illustrates the construction employed where the conduits have to be suspended below the ceiling so as to pass below other work, or for any other reason. Here, longer bolts, slipped through pieces of pipe, are made use of to support the cross pieces of channel iron on top of which the conduits rest.

The Hall Switch and Signal Company, of Montreal, have been awarded the contract for the equipment for train despatching by telephone on the Intercolonial Railway between St. John and Moncton, N.B.

Cooking By Electricity

Electricity as a safe, clean and easily controlled heat source offers numerous advantages when employed for cooking purposes, and with the advent of cheap electrical energy, cooking by electricity is certain to become more general.

For household cooking the complete electric range is doubtless the most convenient and satisfactory. Separate heated utensils have their advantage of course, and in many cases are indispensible, but the housewife or the cook appreciates the electric range with its oven, its broiler and its hot plates, which enable her to perform the operation of cooking in the accustomed manner and with the ordinary utensils.

The product of the electric oven is generally conceded

Fig. 1.

to be much superior to that of gas or other stoves. This is largely, no doubt, due (1) to the fact that in the electric stove the moisture is retained in the food; (2) neither is there the same danger of extremely hot temperatures which often result in burning, as the control of the temperature in an electric stove is much simpler; (3) the healthfulness of the electric stove as compared with others using gas or coal is also a very large factor in favor of the electric; (4) from the point of view of cleanliness also the electric is much superior; (5) the cost of operation which has always been the argument used against electric stoves will be seen from figures that follow to compare very favorably with the operation of gas stoves. Companies are now getting into the habit of giving a special rate for cooking, but even without this concession it is safe to say that the electric stove is now in a position to hold its own with the other kinds.

The new type "R" range which is being placed on the market by the Canadian General Electric Company as illustrated herewith contains many distinctive features of design and workmanship. The design supercedes their D 40 Domestic range and embodies the results of extended research and practical experience with special reference to more efficient heat storage and ventilation.

The encased wire design of heating element which is

used in all devices of this range, provides improved thermal contact between the unit and the working surface, while its small mass insures a minimum heat lag. The result is, quick heating and high efficiency. Higher temperatures than are possible with mica insulation can also be obtained.

The economy in cost of operation of the range is a noteworthy feature. Representative menus for four and five persons have been prepared at a total monthly cost of $3.00 with electricity at 3c per kw.hr. The connected load is reduced from 6 kw. or more (as in many former ranges) to 3.6 kw. For the representative menus the maximum demand was 2.85 kw. and the average daily consumption was 3.28 kw.h.

This range combines practicability with artistic outlines and attractive appearance All exposed surfaces will have

Fig. 2.

a blued steel finish which resembles gun metal, is durable and easily maintained.

Some of the important innovations not previously referred to are noted below:—

Encased wire heating units.

Thermally insulated cooking compartments.

Steam-proof casings inside oven and cooking compartments which have rounded corners to promote cleanliness

Thermally insulated stoves.

Non-rusting metal throughout.

Some Actual Figures

Before placing this range on the market, the company have tested it out in practical cooking operations under many different conditions and some of the figures obtained are given herewith. The dinners would appear to be rather above the average in size and sufficient in many cases for 10 or 12 persons. The full day, however, may be fairly taken to be representative of the average family needs.

The average maximum demand of a range when preparing these meals was 2.85 kw. while with six different ranges the resultant maximum demand was only 9.6 kw. instead of 17.1 kw. (6 × 2.85) thus showing a diversity factor of 56 per cent.

Menu No. 1 For Average Family

Breakfast	Amount	Mins.	Watt-hr.	Total Watt-hr.
Corn Flakes .				
Fried Eggs ..	5 eggs	6	114	
Toast	8 slices	11	112	
Coffee	1 qt.	18	140	366
Dinner				
Roast Beef .	6 lbs.	135	1925	
Mashed Potatoes .	2 lbs.	63	203	
Backed Macaroni.	½ lb.	30	486	
Caramel Pudding .		20	345	
Coffe	1 qt.	16	126	3085
Supper				
Creamed Codfish .			88	
Pop Overs	12	44	764	
Preserves				
Tea	1 qt.	10	178	1030
		Total		4481

Menu No. 2 For Average Family

Breakfast	Amount	Mins.	Watt-hr.	Total Watt-hr.
Oatmeal	1½ pt.	38	192	
Meat on Toast ..		5	90	
Toast	10 slices	15	162	
Coffee	1 qt.	18	137	581
Dinner				
Soup	1 qt.	15	180	
Steak-broiled ...	3 lbs.	35	607	
Steamed Potatoes	2 lbs.	64	242	
Vegetable Salad .				
Suet Pudding ...	10 individual	65	191	
Coffee	1 qt.	18	128	1348
Supper				
Beef warmed up .		6½	96	
Boiled Potatoes .	2 lbs.	53	273	
Bread				
Tea	1 qt.	8	139	
Cake	1½ lbs.	54	436	934
		Total		2875

Menu No. 3 For Average Family

Breakfast	Amount	Mins.	Watt-hr.	Total Watt-hr.
Corn Flakes				
Fried Bacon	½ lb.	11	188	
Fried Eggs	5 eggs			
Muffins		44	620	
Coffee	1 qt.	18½	140	948
Dinner				
Lamb Chops	10	11	276	
Creamed Potatoes.	2 lbs.	12	167	
Green Peas	2 cups	11	71	
Apple Pie	2 pies	60	768	
Coffee	1 qt.	18	142	1424
Supper				
Baked Beans	2 cans	30	93	
Toast	10 slices	14½	155	
Sauce				
Tea	1 qt.	12½	212	460
Cake				
		Total		2832

The Canadian Pacific Railway Company have awarded a contract for the construction of their tunnel through Roger's Pass to McIlwel & Sons, Denver. The work is to commence on January 1 and be completed within three years from that date.

Why I Need an Electric Sign

Because advertising is an investment and not an expenditure.

Because electric advertising is conceded to be the most judicious and practical of all advertising.

Because this is an age of electricity.

Because an electric sign tells who I am, what I sell, and where I am.

Because the best advertising experts in the world recognize the value of the electric signs and rank them higher than any other advertising display.

Because the most successful and wisest merchants in the land use electric signs.

Because this is an age of individualism.

Because persons on the street see ahead and not cross-eyed, so that my nameboard over the door and even my elegant windows may not be noticed by 90 per cent. of the passers-by.

Because an extended sign is viewed at a distance and by its psychological "power of suggestion" may create a demand from an old customer or bring me a new one.

Because an electric sign is the best insurance against business decay.

Because it shows I am not a "back number"; but that I am in line with progress and in the band-wagon every minute.

Because people naturally seek the bright places and an electric sign will make my store more attractive.

Because an electric sign works for me night and day, and unlike other forms of advertising, has an unlimited circulation.

Because more than one business has been pulled out of the rut by an electric sign.

Because I am losing money every day that I don't get an electric sign.

Because I will have to get an electric sign sooner or later and "there is no time like the present."

Because I want to be a leader. Let others follow if they will, but I prefer to get my sign up first and not be forced later on to recognize "the other fellow's" business acumen and good sense.

Because I don't keep open nights is no reason at all why I shouldn't buy a sign. Neither do banks, department stores, and many other businesses remain open evenings, and in every locality they use Electric Signs; that is in every locality that teems with business and is prosperous.

Because spasmodic, occasional, "once-in-awhile" newspaper or circular advertising has only temporary, fleeting advantages and in the long run costs many times the maintenance of a sign. The time to advertise is all the time, and only an electric sign does this.

Because its advertising influence is greatest and can not be escaped, at a time when the mind of the average person is in a receptive mood; and the public takes in advertising devices that are absolutely unnoticed in the ordinary rush of the business day.

Because even if I have been established in business "so long that everybody knows me," I recognize the falsity of that foolish conceit, for I know that new families move into my town, young people grow up, and their parents' allegiance to me may mean nothing to them.

Because an electric sign is a permanent improvement to my "front," one that will give me a great advantage over my competitor. The cost of a sign melts into insignificance when I figure it is good for ten or twenty years.—Electric Sign Journal.

The Birmingham city council has decided to grant the free use of electric cars of the city to blind persons. The estimated maximum revenue loss to the city is $500 per annum.

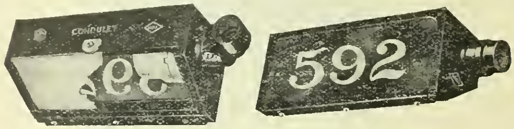
Continued Use of Old Code Wire

A matter of general interest to electrical contractors has been brought to our attention during the past week, with reference to the continued use of old code wire. The requirements of the code should by this time have been sufficiently advertised that no one can plead ignorance. One electrical contractor will be out considerably in his calculations as the result of his failure to meet the requirements, and we print the following item, received from one of our correspondents, for the guidance of any others who may be thinking of following similar practices. Though the hardship is evident, so is, also, the justice of the action of the Underwriters' Association.

"One of the representatives of the fire insurance interests of Western Canada recently had occasion to examine the electric installations in two buildings being erected for the Canadian Bank of Commerce in the west. The bank authorities called for the Underwriters' certificate of acceptance of the wiring and when their inspector visited the buildings in question, he found that old code wire had been used in both installations and that the specifications called for new code wire. The local contractor tried to get around this by endeavoring to show that in his home town the use of old code wire was still permitted. Under the circumstances, however, the Underwriters' inspector had to turn the job down and, his action being fully upheld by the bank authorities, both buildings had to be rewired from top to bottom."

House-Number Condulet

The illustrations herewith represent a new type of condulet being placed on the market by the Crouse-Hinds Company and known as the "house-number" condulet. These condulets show the house number and, when properly located, the lamp will also illuminate the steps and door. Two



styles of separable swivel hubs are made, one straight and the other a 90 deg. hub, which are interchangeable on any of the company's condulets. The front glass can be furnished with any number of letters desired, not exceeding five characters. Any incandescent lamp with dimensions not exceeding 2½ x 4⅝ inches can be used.

New Publications

The Westinghouse Electric & Manufacturing Company have just issued a number of pamphlets covering railway line material. Catalogue section DS840 covers suspensions, ears and splicers. Different types of trolley suspensions are illustrated and described therein; and also various accessories such as expansion bolts, insulators, clinch ears, trolley splicers, strain ears, wire chucks, etc., are listed and illustrated in a convenient manner.

Section DS841 covers frogs, crossings, section insulators, switches and lightning arresters. The well-known Detroit trolley frog and other types are fully described and illustrated; also the different types of trolley crossings, both rigid and adjustable. In the lightning arrester section, pole type lightning arresters, together with fittings such as ground plate, ground point and cap, grounding bonds, etc., are fully described, together with the proper method of making ground.

Section DS844 covers strain insulators of various types and for different kinds of service.

Section DS850 covers rail bonds and bonding tools. This pamphlet gives in some detail the methods of manufacture of rail bonds, and also some carefully prepared information

on the selection of rail bonds. Tables are given showing the net weight in pounds per hundred bonds, and installation views of different types of bonds are shown. Rail bonding tools such as ratchet drills, facing tools, bonding punch, bond compressor, etc., are also described and illustrated. There is also given an illustrated description of portable grinders, torches and clamps.

Uni-Set Combination Devices

A relatively inexpensive means of adapting electric table cooking on a more or less extensive scale is provided by the various combinations of the Uni-Set devices as manufactured by the Canadian General Electric Company, Limited. You can have an electric stove, chafing dish, coffee percolator, tea samovar, egg boiler, baby milk warmer and cereal cooker by buying the complete set. In so doing you save the price of three electric stoves as one Uni-Set stove serves for all of these parts or "units." On the other hand, if you can't afford a complete set you can buy, for example, a Uni-Set chafing dish or a coffee pot to start with and gradually add to it by buying the other Uni-Set parts or "units"—that is, the devices less the stove.

Larger Quarters for the J-M Company

The Toronto branch of The Canadian H. W. Johns-Manville Company, Limited, announces removal to more spacious quarters at No. 19 Front street east. This new store and warehouse has a floor area of approximately 35,000 sq. ft. and is situated in the heart of the wholesale district. In their new quarters this firm will be able to carry a larger stock and have ample space for the display of their complete line of J-M asbestos roofings, packings, pipe coverings, building materials, electrical and railroad supplies, automobile and plumbing specialties, etc. The entire building will be lighted by their well-known Frink and J-M linolite system of lighting and one room will be used for exhibiting these systems of lighting.

J. D. Lachapelle & Company

Mr. J. D. Lachapelle has severed his connection with R. E. T. Pringle and will continue the business of engineers and manufacturers' agents under the name of J. D. Lachapelle & Company. His offices will be at 519 Canadian Express Building, Montreal. The new company will represent, in Canada, among others, the C. & C. Electric and Manufacturing Company, the Detroit Hoist and Machine Company, the Oil, Motor and Manufacturing Company, and will also deal in arc lamps, electric drills, reamers, storage batteries, and ornamental street lighting standards. Mr. Lachapelle is well known in the Canadian electrical field with which he has been connected for some twenty years, much of which time has been spent in connection with electrical installations of many kinds in industrial work.

Hamilton Section C.E.A.

The annual meeting of the Hamilton Electric Light & Power Company section of the C. E. A. was held in their meeting rooms at the Terminal Station, Hamilton, on Thursday, December 4th. A paper from the Electric Bureau of the N. E. L. A. on "The Evolution of the Transformer" illustrated with lantern slides was presented by Mr. W. Dorland. A social programme followed, Mr. W. E. Goring presiding at the piano very acceptably. The following officers were elected:—Honorary president, Mr. Wm. C. Hawkins; honorary vice-president, Mr. E. P. Coleman; president, Mr. W. Dorland; vice-president, Mr. Geo. D. Fearman; secretary-treasurer, Mr. Geo. H. Goring; executive committee, Messrs. L. W. Pratt, Hugh Lennox, W. G. Angus, and C. H. Fry.

Automatic Telephones

The British Postmaster General has announced that after a fairly exhaustive test the Postal Department of the United Kingdom purposes spending $500,000 in establishing further automatic telephone exchanges. The announcement states that while the telephonic service in America is more efficient than in England at present, it is not so efficient as theirs will be eventually.

New Companies

The Alberta Hydro-electric Company, Limited, has been incorporated, with head office at Calgary.

The Lachine Rapids Power Company has been incorporated with head office at Montreal.

The Vaudreuil Electric Company has been incorporated with a capital stock of $50,000.

Trade Publications

Telephone Selector.—A booklet issued by the General Railway Company illustrating and describing the equipment used in their selector system.

The Auto-Electric-Cook:—A catalogue just off the press and being distributed by the Automatic Electric Cook Company, Limited, of Toronto, introducing the Auto-Electric-Cook Stove, which is stated to be a most economical servant, an automatic cook, and an ideally perfect stove.

Industrial Lighting.—Bulletin 20 issued by the Engineering Department of the National Illumination Works of the General Electric Company containing much useful information on the requirements of good illumination in industrial plants.

Condulet Pocket Reference.—A booklet issued by the Crouse-Hinds Company of Canada, similar to their original pocket reference on the subject of Condulets but containing much new information on additional types of equipment now being placed on the market by this company. The booklet is of a size that can be conveniently carried in the pocket, is well illustrated, and contains much useful information on the subject of electric fittings.

Household Appliances.—Catalogue No. 18 issued by the Simplex Electric Heating Company, Cambridge, Mass., describing and illustrating their electric heating appliances for cooking and miscellaneous purposes. The Canadian branch of this company is in Belleville.

Hydro-electric Power Developments.—Bulletin No. 4966A issued by the Canadian Allis-Chalmers Company, Limited, describes a few of the hydro-electric plants installed in recent years in which Canadian General Electric and General Electric units have been used. The booklet is illustrated with photographs of some of the more famous generating stations in America.

Boilers.—Bulletin No. 6 issued by the International Engineering Works, Limited, describing Robb water tube boilers. The bulletin is well illustrated and contains useful information on the operation of this equipment.

Single Phase Converter.—Bulletin No. 103 issued, in miniature, by the Wagner Electric & Manufacturing Company, describing, with illustrations, their single-phase converter used for changing alternating current to direct current, for such purposes as lantern work, battery charging, X-ray work and driving d.c. motors for general applications.

If your Electrical News does not reach you promptly, kindly advise our Subscription Department without delay.

Current News and Notes

Amherst, N.S.

Negotiations are proceeding between the Canada Electric Company and the town council regarding improvements in the street lighting system.

Barrieville, Ont.

The wireless apparatus to equip the new Marconi station at this point has arrived and the generating equipment is expected in a few days. It is believed this plant will be operating early in the new year.

Brockville, Ont.

At a recent sitting of the Ontario Railway and Municipal Board, held in Brockville, Chairman McIntyre, heard deputations from the Athens, Plum Hollow and Eloida Rural Telephone Company and the Mallorytown and Lyn Company, who make applications to have the two lines connected. An order was made granting the request. When the order is carried out it will mean the last link in the chain connecting the trunk lines of the different rural telephone companies doing business in Leeds and Grenville.

Brandon, Man.

Mr. C. Chamberlain met the Brandon city councillors at a special meeting on November 19, and outlined a proposition to bring power to this city from Silver Falls. The following prices were mentioned:—1,000 h.p., at $40 per h.p. per annum; 1,250, at $39; 1,500, at $38; 1,750, at $37; 2,000, at $36; 2,250, at $35; 2,500, at $34; and so on down to 3,500 h.p. for $30.

Beausejour, Man.

A by-law was recently passed authorizing the expenditure of $3,000 on an electric light system.

Chatham, Ont.

Negotiations are in progress between the city council and the Chatham Gas Company regarding the purchase of the property of the company to be operated municipally.

Courtright, Ont.

The installation of a municipal electric lighting plant has been suggested. Also a proposition has been made by a private party to install a gasoline electric plant for the purpose of lighting the town.

Cornwall, Ont.

Canadian Cottons, Limited, have just started up a 625 kw., 2200 volt, 3-phase, 60-cycle, 275 r.p.m. Swedish General Electric generator, supplied by Messrs. Kilmer, Pullen & Burnham. This is replacing water and steam drive which up to the present time has been used generally for motive power in this plant. The new generator is driven from the turbines already installed and is connected to them by a rope drive. A 10 kw. exciter is driven from the generator shaft by a Reynold silent chain. Some twenty Swedish motors have also been installed at different points in the plant. These vary in size from 25 h.p. down. These are in addition to a number of old motors which have been operating for some time on current purchased from the St. Lawrence Power Company.

Collingwood, Ont.

The town has closed a contract with the Imperial Steel & Wire Company to supply electric energy to the latter to the extent of 350 h.p. This brings the consumption of electric power in Collingwood to over 700 h.p. Power is purchased by the town from the Hydro-electric Power Commission of Ontario who transmit from Severn River.

Dalhousie, N.S.

The municipal electric light plant was placed in operation on December 1. This plant consists of a producer gas unit, an engine, and 75 kw. generator supplied by the Canadian General Electric Company and installed under the supervision of Chipman & Power, engineers.

Davidson, Sask.

This town has installed a producer-gas electric plant for supplying light and power. The equipment consists of a producer plant having a capacity of 125 h.p., a 3-cylinder, vertical, producer-gas engine of 80 h.p. capacity and a direct connected 75 kv.a. generator. The producer plant and engine are being supplied by the Canadian Producer & Gas Engine Company, Barrie, Ont., and the generator by the Canadian Westinghouse Company.

Fernie, B.C.

The city of Fernie expects to purchase within the next seven months an automatic voltage regulator for four-wire, two-phase, 60-cycle, 2400-volt current for two machines (150 kw. each); S. K. C. system, one switchboard wattmeter, poles and wires for construction of 3 miles of distribution lines, 100 5-amp. and 10-amp., 110-volt, 60-cycle, single-phase, two-wire meters. James E. Finn is superintendent of the municipal electric plant.

Hull, Que.

The Hull Electric Company have placed an order with the Ottawa Car Company for four, 43-foot semi-convertible single-end trailer car bodies.

The matter of extensions to the Hull Electric Railway's system from Hull to Gatineau Point is being discussed in the city council.

Hantsport, N.S.

Several propositions have been made to the town council for lighting the town by electricity. The matter will probably be put to a vote in the near future.

Humboldt, Sask.

A by-law was submitted to the electors on December 8. This was for defraying the cost of completion of the electric lighting plant and making extensions in the pole line.

Hamilton, Ont.

The contract has been awarded to the Canadian Westinghouse Company for electrical machinery and equipment to be installed in the Dundurn sub-station.

A by-law to authorize the expenditure of something over $1,000,000 for hydro-electric purposes is to be submitted in January.

Work has begun on the sub-station building on Dundurn street which is being built in connection with the municipal distributing system.

Lacombe, Alta.

We understand the town council will, in the near future, purchase a 100 kw. generator.

Lindsay, Ont.

The new street lighting equipment was placed in operation on December 1 along the main street of the town. The

system used is an iron standard carrying magnetite arc lamps. Wires are placed underground.

LePas, Man.

The wireless station at this point has been placed in commission and it is reported that messages can now be taken from points on the extreme east and west of the Dominion.

London, Ont.

The city has appointed the following commission to have charge of the electrification and operation of the London & Port Stanley Railway:—Hon. Adam Beck, Philip Pocock, Ald. Spittal, M. D. Faser, K.C., and the Mayor.

It has been finally decided to take a vote, at the January elections, on the operation of Sunday cars.

Medicine Hat, Alta.

On November 21 a by-law authorizing additional expenditures of $150,000 for power plant extensions and improvements was passed.

Montreal, Que.

Mr. C. Laurendeau, K.C., the chief attorney of the Montreal Council, has reported to the controllers that the Montreal Light, Heat and Power Company and the Public Service Corporation have the right to make use of the streets for their poles without the consent of the city. The companies were bound to give notice of what they were going to do, in order to give the city an opportunity to say where the poles were to be placed. The city may notify them that it believes it preferable that the wires be placed underground. If the companies refuse this request the city have the right to apply to the Public Utilities Commission to force the companies to put their wires in conduits; the decision rests with the Commission. The city are seeking power to amend the charter with regard to the erection of poles. The new clause will put all companies of public utilities on the same footing as regards their relations with municipal corporations, and make it obligatory on such companies to obtain the consent of municipal corporations before exercising any privileges in the streets. If a company and a municipal corporation do not agree on the conditions to be imposed, the matter is to be submitted to the Quebec Public Utilities Commission, which will decide between the parties.

Tenders are to be received by the Board of Commissioners up to December 18 for the installation of an electric clock system in the city hall annex.

The Bell Telephone Company will erect a new exchange on Ontario Street East, Montreal, at a cost of $215,000.

Under a Bill promoted by the village of St. Michel de Laval, near Montreal, the Quebec Legislature is asked to give authority to the municipality to enter into a contract for the construction and operation within its limits of an electric tramway service and to grant to any firm or corporation an exclusive franchise and exemption from municipal taxes for a period not exceeding fifty years. The Bill is strongly opposed.

Murray Bay, Que.

The Labrador El. & Pulp Company, Limited, of Murray Bay, expects to purchase within the next six months one 250 h.p. engine to operate an alternating-current generator for lighting the city; also within the next four months to purchase two transformers (10,000 kw.) and 50 cedar poles for repairing 20 miles of lines. J. O. Duguay is manager.

Nelson, B.C.

The city's railway receipts are showing up considerably better than last year. For the first three weeks of November the average daily receipts were $39.64, as compared with $32.88 a year ago.

Orillia, Ont.

The Hydro-electric Power Commission of Ontario have been approached for a proposition to supply the town with power continuously from Big Chute. This would thus do away with the suggested installation of a new plant by the town of Orillia. Chief Engineer Gaby has been looking over the situation.

Princeton, B.C.

The Princeton Coal & Land Company have called for tenders for electrical equipment which, we understand, will cover the generation and distribution of a quantity of power for both motor and illumination work.

Port Arthur, Ont.

The Niles Car and Manufacturing Company of Cleveland are considering the establishment of a car factory at this point.

Picnic, Sask.

The Graham-Chatsworth Rural Telephone Company, Limited, have called for tenders for the construction of a telephone system at this point.

Rossland, B.C.

The council is looking into the matter of installing a new street lighting system.

Regina, Sask.

The operating returns of the municipal street railway system for the week ending September 29 were as follows:—Revenue, $4,263.55; passengers carried, 102,088; passengers, including transfers, 116,405.

The following rural telephone companies have been incorported in Saskatchewan: Grand Bend Rural Telephone Company, Limited, Weyburn; Hillsdale Rural Telephone Company, Limited, Simpson; Tantallon Rural Telephone Company, Limited, Tantallon; Durham Rural Telephone Company, Limited, Wolseley.

The city of Regina has awarded a contract to Messrs. Willans & Robinson for a 3,000 kw. disc and drum turbine operating at 3,600 r.p.m., with steam at 180 lbs. pressure and 125 degrees super heat. The generator will be supplied by the Siemens Company of Canada and will be 3-phase, 60-cycle, 2200 volt. The turbine condenser will also be of the Willans & Robinson manufacture, of the Augmenter type, with an Edwards air-pump. The contract for the supply of a 25-ton hand operated travelling crane was awarded to the Whiting Foundry & Equipment Company. This equipment will be installed under the supervision of Mr. E. W. Bull, superintendent Light and Power Department of the city of Regina.

It is expected that the 1500 kw. turbo-generator unit will be installed in temporary housing and ready for operation by the new year. In a report recently issued it is stated that the output of the plant during the first ten months of 1913 amounted to 6,917,619 kw.h., an increase of about 90 per cent. over the amount produced a year ago.

A contract for the supply of a 3,000 kw. steam turbine with condenser has been awarded to Willans & Robinson. A 25-ton crane will be supplied by the Whiting Foundry & Equipment Company.

Saskatoon, Sask.

Ten street car conductors and one motor man were recently placed under arrest here for abstracting fares from boxes of the municipal railway system. The discovery was made by private detectives who first located one of the men

as the leader of a systematically organized enterprise. It is understood that this man has made an open confession involving the others arrested.

Two of the six street cars on order have arrived. These are of the double deck p. a. y. e. type, with a considerably larger capacity than the older cars.

For the first ten months of the year the total output of Saskatoon's power plant was 6,225,775 kw.h., as against 2,934,375 kw.h. for the corresponding period a year ago, or an increase of approximately 112 per cent. The highest peak load was 2,900 kw. A 3,000 kw. steam turbo-generator is at present being installed. During the month of October, just past, the commissioners report that 905,390 kw.h. were generated at a cost of $17,679, which works out to 1.95c per kw.h.

During the same ten months, 107 arc lamps have been erected bring the total number at the present time up to 270. The main streets are lighted by ornamental standards using tungstens.

For the first ten months the gross receipts from the street railway system have been $132,124, as against all charges of $144,520. At the present time 12 single truck cars operating with a seating capacity of 32 passengers each. Six new double truck cars are on order with a capacity of 44 each.

St. Thomas, Ont.

The city council is contemplating the installation of an ornamental cluster lighting system on the main streets.

St. Catharines, Ont.

The new electric line from St. Catharines to Niagara-on-the-Lake was opened for service on the first of December.

Shoal Lake, Man.

A by-law will be submitted on December 16 authorizing the issue of debentures to raise $15,000 for an electric light plant in Shoal Lake, Man., the debentures to run for 20 years and bear interest at 5 per cent. In our December 1 issue we stated in error that the date of this by-law was January 1.

Toronto, Ont.

The Wilton Avenue car line of the Toronto Railway Company has been placed in service.

The city solicitor has been instructed to look up all the franchises regarding underground railways in the city of Toronto with a view to having any cancelled which have not been lived up to.

Tilbury, Ont.

A by-law will be submitted on January 1 to raise money for the cost of installing a distribution system for electric light and power. The by-law will be for $10,000 which it is calculated with be sufficient to distribute 250 h.p.

Vancouver, B.C.

A local syndicate has made application to the city council for a franchise to operate motor buses on the streets and lanes of Vancouver. The application asks for a 20-year franchise, with exclusive rights, and in return agrees to charge the same fares as formerly given by the B. C. E. R. Company.

It is said that the railway department of the British Columbia government are conducting an investigation into the British Columbia Electric Railway Company's rates.

Watrous, Sask.

We are advised that the report that this town would submit a by-law authorizing the expenditure of $8,500 on an electric lighting plant was in error. There is no project to submit such a by-law.

Woodstock, N.B.

An application has been received from the Maine and New Brunswick Electric Company to erect poles and stretch wires in this town for the supply of light and power.

Wyoming, Ont.

An electric lighting system is contemplated in this town.

Welland, Ont.

The Electric Steel & Metals Company have commenced excavation work on the erection of their steel plant which will be built in part during the coming winter.

Weston, Ont.

It is expected that work on the re-distribution of the lights on Main Street will shortly be undertaken by the Weston Power & Light Commission.

Walkerville, Ont.

The ratepayers recently approved a by-law regarding the adoption of Niagara power to be supplied by the Hydro-electric Power Commission of Ontario.

Winnipeg, Man.

Tenders have been called by the Manitoba Government Telephone Commission for their supply of telephone instruments for the year 1914.

A contract has been awarded by the Board of Control to the Siemens Company of Canada for the supply of one 1500 kw. motor-generator set for the King Street sub-station.

LIGHTING SCHEDULE FOR DECEMBER, 1913.

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. o Hours
Dec. 1	5 00	Dec. 2	6 20	13 20
2	5 00	3	6 20	13 20
3	5 00	4	6 20	13 20
5	10 40	6	6 30	7 50
6	11 40	7	6 30	6 50
8	0 40	8	6 30	5 50
9	1 40	9	6 30	4 50
10	2 50	10	6 30	3 40
11	3 50	11	6 30	2 40
12	No Light	12	No Light	
13	No Light	13	No Light	
14	No Light	14	No Light	
15	5 00	15	8 00	3 00
16	5 00	16	9 10	4 10
17	5 00	17	10 30	5 30
18	5 00	18	11 40	6 40
19	5 10	20	0 50	7 40
20	5 10	21	2 00	8 50
21	5 10	22	3 20	10 10
22	5 10	23	4 30	11 20
23	5 10	24	5 50	12 40
24	5 10	25	6 40	13 30
25	5 10	26	6 40	13 30
26	5 10	27	6 40	13 30
27	5 10	28	6 40	13 30
28	5 10	29	6 40	13 30
29	5 10	30	6 40	13 30
30	5 10	31	6 40	13 30
31	5 10	Jan. 1	6 40	13 30

Total Hours 249 40